

Source Investigation

RI/FS Quality Assurance Project Plan Addendum No. 1

Griggs and Walnut Avenue PCE Groundwater Plume

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A review of potential sources of tetrachloroethylene (also known as perchloroethylene, or PCE) in the vicinity of the Griggs and Walnut Ground Water Plume (GWP) Superfund Site has been performed. This review included potential sources identified in the Hazard Ranking Scoring package for the site, and the identification of the location of current and historical dry cleaners and other facilities that might potentially have used PCE in the area of the site. In addition, a search was performed to locate facilities in Las Cruces identified in the RCRIS and CERCLIS databases, performed using the EPA's Envirofacts website. Based on the review of the potential point sources in the area of the plume, activities for a Source Investigation (SI) were suggested to the Environmental Protection Agency (EPA) for determining if point sources of the ground water contamination could be located. These activities were included in a technical memorandum (TM) submitted to EPA as an addendum to the Technical Activities Work Plan (TAWP), Version 1.3 (**CH2M HILL, 2002a**, and **CH2M HILL, 2002e**). The activities described in the TAWP Addendum are designed to provide data concerning potential source areas and data to be used in support of the Remedial Investigation (RI).

Applicable changes to the field procedures for the Source Investigation work are addressed in the Addendum No. 1 to the Field Sampling Plan Version 1.1 (**CH2M HILL, 2002f**). The purpose of this Addendum is to incorporate changes into the Quality Assurance Project Plan (QAPP) Version 1.1 (**CH2M HILL, 2002b**) that are a result of the additional activities to be

conducted during the SI. Also applicable to the work is the Site Management Plan, Version 1.1 (**CH2M HILL, 2002d**) (the SMP did not require changes for the source investigation portion of the work).

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Attachment C	Descriptions of Analytical Methods

1.0 Introduction

This addendum to the Griggs and Walnut Remedial Investigation/Feasibility Study (RI/FS) QAPP (**CH2M HILL, 2002b**) has been prepared to incorporate and describe quality assurance/quality control (QA/QC) procedures for activities to be conducted in support of a Source Investigation (SI) to be conducted for the site. An overview of the work tasks to be conducted is provided in the addendum to the RI/FS TAWP (**CH2M HILL, 2002a** and **CH2M HILL, 2002e**).

1.1 Site Description and Background

The GWP Site is a plume of ground water contaminated with PCE. The plume is centered near the intersection of Griggs Avenue and Walnut Street in Las Cruces, Doña Ana County, New Mexico. A more detailed description of the site history, potential sources of contamination, nature and extent of contamination, and site environmental setting are provided in the TAWP and its Addendum No.1 (**CH2M HILL, 2002a** and **CH2M HILL, 2002e**).

As stated in the RI/FS QAPP (**CH2M HILL, 2002b**), QA involves all those planned and systematic actions necessary to provide adequate confidence that field activities will be performed satisfactorily and safely. The goal of QA is to ensure that activities are planned and performed according to accepted standards and practices to ensure that the resulting data are valid and useable for the project decision-making process, while continuing to meet safety requirements. QC is an integral part of the overall QA function and is comprised of all those actions necessary to control and verify that project activities and the resulting data meet established requirements.

The requirements of this document apply to CH2M HILL and its subcontractors. Deviations from these procedures will be documented and included in the final report.

Provided in **Section 1** of this QAPP Addendum No. 1 is a description of the project management responsibilities and data objectives. **Section 2** describes the measurement and data acquisition procedures, and analytical methods to be used for this event. **Section 3** provides a description of assessment and oversight responsibilities. **Section 4** discusses the data review, validation, and verification requirements, and **Section 5** contains references. Where applicable, for information unchanged by this addendum, the reader is referred to the RI/FS QAPP Version 1.1 (**CH2M HILL, 2002b**).

1.2 Project QA/QC Roles and Responsibilities

The key project team members associated with the planned sampling event and the QA/QC responsibilities associated with each position are listed in **Section 1.2** of the QAPP Version 1.1. The organizational structure and responsibilities are designed to provide project control and quality assurance for the proposed investigation. The project team and their roles are also shown on **Figure 1-1** of the QAPP.

1.2.1 Laboratory Work Group

Up to four separate laboratories will be responsible for analysis of samples collected during field activities. These four labs will include a Contract Laboratory Program (CLP) laboratory, the EPA Region 6 laboratory, an onsite soil vapor laboratory, and an offsite subcontracted laboratory. In addition, some sample analysis will be performed in the field using a field portable gas chromatograph (GC). Further discussion of issues related to each laboratory is provided in **Section 2** of this Addendum. For the samples that are not analyzed through the

CLP program, the laboratory PM or client services manager (CSM) acts as a liaison between field and laboratory operations. The EPA Regional Sample Control Coordinator (RSCC) will be a liaison regarding analytical, data validation, and quality assurance issues for the samples analyzed through the CLP.

1.2.2 Project Communication

Project communication activities, requirements, and guidelines are stated in **Section 1.2.2** of the QAPP Version 1.1.

1.3 Problem Definition and Background

Details regarding previous investigations at the site are summarized in **Section 2.1.1** of the TAWP and its Addendum No. 1 (**CH2M HILL, 2002a**, and **CH2M HILL, 2002e**) and in **Section 1** of the Field Sampling Plan (FSP) (**CH2M HILL, 2002c**). Additional details can be found in the Hazard Ranking System (HRS) documentation Record (**EPA, 2000b**).

1.4 Project Objectives and Data Quality Objectives

The objective of the SI is to collect data that is sufficient for determining whether or not sources of the PCE contamination exist at several locations in the vicinity, including the DACTD maintenance yard, the former National Guard Armory, the former Crawford Airport/CLC Fleet Maintenance Facility, or at the PCE tank location at the CLC Fleet Maintenance Facility. In addition, wells are planned to evaluate the potential for upgradient sources to exist west of the known extent of the plume. For more detail on the objectives of the

investigation, refer to the TAWP **Table 4-1 (CH2M HILL, 2002a)** and the TAWP Addendum No. 1 (**CH2M HILL, 2002e**).

1.5 Criteria for Measurement Data

This subsection defines the levels of data that will be generated as part of the SI work activities. The level of data quality is dependent on the objective use of the results supported by the data. This subsection also provides the quantitative quality objectives and measurement performance criteria for the analytical data.

1.5.1 Levels of Data Quality

Three categories of data will be collected as part of this field effort, and each category has a different level of supporting QA/QC documentation. Level 1 includes field monitoring activities, such as hydrogen (ion) concentration (pH), conductivity, temperature, oxidation-reduction potential (ORP), and dissolved oxygen (DO). In addition, samples analyzed on-site using the field portable GC are considered Level 1. Samples that are not analyzed through the CLP program will be submitted to the laboratories for level 3 analyses. These samples include samples collected for the characterization of investigation-derived waste (IDW). Samples that are analyzed through the CLP program and/or EPA laboratory will be submitted to the laboratory for level 4 analyses. **Table 1-1** summarizes the analytical levels that are considered appropriate for each type of data use identified for this SI, the types of analyses, the limitations, and the data quality expected from that analytical level. For each QC level, the measures and methods to be used, as well as the applicable data package deliverables, are outlined in **Section 1.5.1** of the QAPP Version 1.1.

1.5.2 Quality of Data

Analytical performance requirements are expressed in terms of precision, accuracy, representativeness, comparability, and completeness (PARCCs). Summaries and brief definitions for each PARCCS parameter, and calculation equations as appropriate, are included in **Section 1.5.2** of the QAPP Version 1.1.

1.6 Special Training Requirements and Certifications

The PM works with the RAC6 program manager to assemble a project team with the necessary experience and technical skills. Part of the work planning process is to identify special training requirements and certifications necessary to execute the project successfully. The only special training requirement necessary for this project is operation of the field portable GC. The field team will be trained by a CH2M HILL chemist in the proper operation of the field portable GC.

1.7 Documentation and Records

Documentation and record keeping requirements are discussed in **Section 1.7** of the QAPP Version 1.1. The same requirements will apply to the SI.

2.0 Measurement and Data Acquisition

This section describes the sampling process design, sampling methods, and sample handling and custody.

2.1 Sampling Process Design

The design of the data collection process for the SI is described in the FSP Version 1.1 Addendum No. 1 (**CH2M HILL, 2002f**). Included therein are the types and numbers of samples required, the design of the sampling network, the sampling locations, matrices, and frequencies, and the rationale for the design. Data collected during the course of an investigation can be classified as either critical (required to achieve project objectives) or non-critical (informational purposes only). All samples planned for collection as part of the GWP Site SI are classified as critical.

2.1.1 Sample Disposal

The laboratories will be responsible for disposing retained samples in accordance with the contract and applicable regulations. Samples that are collected and analyzed onsite using the field portable gas chromatograph will be containerized at the site and disposed of in accordance with applicable regulations.

2.1.2 Management of Investigation-Derived Waste

Management of IDW is discussed in **Section 7** of the FSP Version 1.1 and details are provided in the Site Management Plan (SMP) (**CH2M HILL, 2002d**). These procedures will be followed during the SI.

2.2 Sampling Methods Requirements

Sampling methods are detailed in **Section 4** of the FSP Addendum No. 1 (**CH2M HILL, 2002f**). Specifics regarding analytical method requirements are provided in **Section 2.4** of this addendum.

2.3 Sample Handling and Custody Requirements

Sample handling and custody requirements are detailed in **Section 2.3** of the QAPP Version 1.1. These same procedures will be followed for the SI. **Section 2.3.1** of the QAPP Version 1.1 discusses field documentation requirements. **Section 2.3.2** of the QAPP Version 1.1 discusses sample containers and preservatives. **Table 2-1** of the current addendum details the sample containers, preservative requirements, and maximum holding times for methods that will be employed during the SI. Sample identification is discussed in **Section 2.3.3** of the QAPP Version 1.1. Sample packing and shipping requirements are included in **Section 2.3.4** of the QAPP Version 1.1, and sample custody procedures are described in **Section 2.3.5**.

2.4 Analytical Methods Requirements

This section includes brief descriptions of the methods and QC required for screening procedures commonly used to conduct work efforts. The methods and QC procedures are from the following:

- C *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (U.S. EPA SW-846, Third Edition, and its first and second and third updates, 1997).*
- C *Methods for Chemical Analysis of Water and Waste (U.S. EPA, 1983).*
- C *ASTM Annual Book of Standards (ASTM, 1993).*

- C *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition. (EPA, January 1999). Compendium Methods TO-14A, 15, 16, 17 EPA 635/R-96-010b.*
- C *Contract Laboratory Program Statement of Work for Organic Analysis, Low Concentration Water (U.S. EPA OLC03.2, December, 2000).*
- C Equipment Manufacturer's Instructions.

There will be up to four different laboratories involved in the analyses of these samples. The analytical screening methods contained in this section, including sample matrix and designated laboratory (if applicable) for each analysis, are shown on [Table 2-2](#). A brief summary of the specific analyses performed by each laboratory is as follows:

- CLP Laboratory/EPA Region 6 Laboratory - CLP Low Concentration Volatile analysis for water samples and Method SW846/5035/8260B for analysis of volatile compounds in soils.
- Onsite Laboratory - Soil Gas Vapor analysis for selected volatile compounds and water analysis for selected volatile compounds.
- Offsite Laboratory - Soil Gas Vapor analysis for selected volatile compounds and IDW sample analysis.
- Onsite Field Portable GC - Onsite analysis of selected volatile compounds.

2.4.1 Field Screening and Analysis Method Descriptions

Various field-screening and field-analysis methods expected to be utilized during the SI field investigation are discussed in **Section 2.4.1** of the QAPP Version 1.1. In addition, samples collected and analyzed onsite using the field portable GC will be considered field screening level data. A description

concerning the standard operating procedure and calibration procedures for the Photovac Voyager field portable gas chromatograph are included in [Attachment A](#). More detailed procedures will be developed once the machine has been made available to the Project Chemist for evaluation and testing. These methods provide Level I or Level II data collection technology/documentation, as indicated on [Table 2-2](#).

2.4.2 Analytical Methods for Selected Volatile Organics

As specified in the FSP Addendum No. 1, an onsite close support laboratory will be used for the analysis of soil vapor from samples collected via direct push technology. The onsite laboratory will analyze the samples following SW846/8021A for selected volatile organic compounds (VOCs). In addition, this laboratory may be employed to analyze soil vapor samples and ground water samples collected during the drilling and installation of monitor wells for selected VOCs. These samples will be analyzed as a check against data obtained from the field portable GC. The ground water samples will be analyzed using EPA method SW846/8260B. Soil vapor samples collected via direct push technology from specific locations will be sent to an offsite subcontracted laboratory for analysis of selected VOCs by EPA Method TO-14A for confirmatory analysis.

2.4.2.1 SW846/8021 — Volatile Compounds

The onsite laboratory will analyze the soil gas vapor for PCE by Method SW846/8021A. A representative aliquot of the sample is introduced into a gas chromatograph, where the compounds are separated, and detected by an Electrolytic Conductivity Detector (ELCD).

2.4.2.2 EPA TO-14A — Volatile Compounds

The offsite laboratory will analyze the soil gas vapor for selected volatile compounds by EPA Method TO-14A. A representative aliquot of the sample is introduced into a gas

chromatograph, where the compounds are separated, and detected by a mass spectrometer (GC/MS). This method is being used in order to reach lower reporting limits for PCE for specific sample locations.

2.4.2.3 Analytical Methods for Organics

Analytical data collected will include organics. SW846 provides the technical framework for commercial environmental testing laboratories to apply SW846 analytical methods for the preparation/isolation, detection, and quantitative measurement of organic and inorganic target compounds in water and soil environmental samples.

The CLP laboratory will analyze the soil and water samples for VOCs following the CLP SOW for organic analysis for low concentration water and CLP modified method 5035 for analysis of soil samples. Samples collection procedures for analysis via CLP modified method 5035 will follow the procedures outlined in [Attachment B](#). The onsite close support laboratory will analyze water samples for VOCs via SW846/8260B. A representative aliquot of the sample is introduced into a GC, where the compounds are separated, and detected by a MS; more information about the method is provided in [Attachment C](#).

2.4.3 Analytical Methods for IDW Samples

This section describes analyses that will be conducted on the IDW samples. Depending on the findings of the SI and the actual disposition of the IDW, not all of the following methods may be run.

2.4.3.1 SW846/1311

The IDW samples will undergo the Toxicity Characteristic Leaching Procedure (TCLP). The “leachate” obtained from this procedure will then be extracted/digested and analyzed by the methods listed in the following subsection. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.2 Organics

The IDW sample and “leachates” will be measured for VOC content. The method to be utilized will be SW846/8260B (for volatile organics). A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.3 Semi-Volatile Organics

The IDW sample and “leachates” will be measured for semi-volatile organic compounds (SVOC) content. The method to be utilized will be SW846/8270C (for SVOCs). A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.4 Pesticides

The IDW sample and “leachates” will be measured for pesticide content. The method to be utilized will be SW846/8081A. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.5 Herbicides

The IDW sample and “leachates” will be measured for herbicide content. The method to be utilized will be SW846/8151A. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.6 Metals

The IDW sample and “leachates” will be measured for metals content. The methods to be utilized will be SW846/6010B and SW846/7470A. A brief discussion of the methods is provided in [Attachment C](#) to this Addendum.

2.4.3.7 Ignitability

The IDW sample will be measured for the characteristic of ignitability. The method to be utilized will be SW846/1030. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.8 Corrosivity

The IDW sample will be measured for the characteristic of corrosivity. The method to be utilized will be SW846/9045C. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.3.9 Reactivity

The IDW sample will be measured for the characteristic of reactivity. The method to be utilized will be SW846/Chapter 7. A brief discussion of the method is provided in [Attachment C](#) to this Addendum.

2.4.4 Reporting Limits and Data Package Requirements

Project-specific method target compound lists and reporting limits are summarized in [Table 2-3](#). The laboratories will provide EPA CLP packages for the VOCs, and EPA CLP packages or equivalent, VOCs and soil organic vapor (SOV) analyses, as listed in [Table 2-4](#) of the QAPP Version 1.1.

2.5 Quality Control Requirements

Quality control samples will be collected and or prepared to facilitate the evaluation of the field sample data quality. The types of QC samples associated with each data quality level are summarized in **Table 2-5** of the QAPP Version 1.1.

2.5.1 Field QC Samples

A discussion of the types of field QC samples is provided in **Section 2.5.1** of the QAPP Version 1.1. Matrix Spike/Matrix Spike Duplicates (MS/MSD) will only be collected for soil analysis during the SI. The MS/MSD requirements are discussed in **Section 2.5.2** of the QAPP Version 1.1. The following field QC sample collection guidelines will be followed:

- Trip Blanks - one trip blank per sample cooler containing VOC water or soil samples will be submitted for analysis.
- Equipment Rinseate Blanks (ERB) - One ERB will be collected for every 20 samples or one per equipment type per day and submitted for analysis.
- Field Blanks (FB) - One FB will be collected for every 20 samples or one for each media type sampled during the sampling event and submitted for analysis.
- Field Duplicate (FD) - For the water and soil vapor samples collected during drilling, a FD will be collected and submitted to an off-site laboratory for every 10 samples analyzed in the field (either using the field portable GC or the onsite close support laboratory).
- Temperature Blank - one temperature blank will be submitted per sample cooler.

2.5.2 Field and Laboratory Corrective Action

The corrective action process is discussed in **Section 2.5.3** of the QAPP Version 1.1. Field corrective action procedures are contained in **Section 2.5.3.1** of the QAPP Version 1.1, and laboratory corrective action is discussed in **Section 2.5.3.2** of the QAPP Version 1.1. These same procedures will be followed during the SI.

2.6 Instrument Testing, Inspection, and Maintenance Requirements

Procedures for inspection/acceptance of environmental sampling and measurement systems/components are described in **Section 2.6** of the QAPP Version 1.1. **Section 2.6.1** of the QAPP Version 1.1 describes procedures for field instruments, and **Section 2.6.2** includes the procedures for analytical laboratory instruments. These procedures will be followed for the SI.

2.7 Instrument Calibration and Frequency

Field instrument calibration requirements are included in **Section 2.7.1** of the QAPP Version 1.1. In addition, the following procedure for calibration of the field portable GC will be followed. **Section 2.7.2** describes the requirements for calibration of analytical laboratory equipment. These procedures will be followed during the SI. Field instrument calibration and frequency requirements are also shown in [Table 2-4](#).

3.0 Assessments and Oversight

The overall requirements for assessments and oversight are discussed in **Section 3** of the QAPP Version 1.1. Assessments and response actions are discussed in **Section 3.1** of the QAPP Version 1.1. This section includes procedures for laboratory and field team performance and systems audits. **Section 3.2** of

the QAPP Version 1.1 specifies the reports to management that are required during the project. These same requirements will be used for the SI.

4.0 Data Review, Validation, and Verification Requirements

Data review and validation procedures are described in **Section 4.1** of the QAPP Version 1.1. Included are discussions for reviewing and validating field survey and analytical laboratory data. **Section 4.2** of the QAPP Version 1.1 discusses the data validation and verification requirements for all data generated during the project. Trend analysis for the data are discussed in **Section 4.3** of the QAPP Version 1.1, and reconciliation with the data quality objectives is included in **Section 4.4** of the QAPP Version 1.1. The same requirements and procedures will apply and be followed for all data generated as part of the SI.

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American Society for Testing and Materials. ASTM Annual Book of Standards. 1993.

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Table 1-1
Summary of Analytical Data Quality Levels
Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico

Data Use	Analytical Level	Type of Analyses	Limitations	Expected Data Quality
Health and Safety, Site Characterization	Level I	Use of Portable instruments and field test kits for total organic vapor detection, water quality parameter measurement, and field screening for VOCs for site characterization	Data is often not compound-specific or quantitative, instruments may respond to naturally-occurring compounds	If instruments are calibrated and data interpreted correctly, can provide real-time indication of contamination or unsafe working conditions
Site Characterization, Evaluation of Alternatives	Level III	Use of on-site, close-support laboratory to provide tentative ID of organic parameters using GC (detection limits low ppb): analyses will be analyte specific	Instruments limited mostly to volatile organics (soil gas)	Data typically reported in concentration ranges, and data quality dependent upon QA/QC procedures employed
Site Characterization, Risk Assessment, Evaluation of Alternatives	Level III	Use of off-site, fixed-base laboratory for organic/inorganic parameters. Volatile compounds analyzed using GC/MS with detection limits to low ppb level. Analysis are analyte-specific. For non-CLP analyses, CLP data package deliverables, documentation, and validation procedures will be followed as closely as possible. For CLP analyses, CLP data package deliverables, documentation, and validation procedures will be followed (Volatile data supplied under CLP protocol will be Level IV).	Parameter identification confirmed.	Non-CLP analyses reporting limits are similar to CLP.
Site Characterization, Risk Assessment, Evaluation of Alternatives	Level IV	Use of off-site, fixed-base laboratory for CLP analyses. Volatile data supplied under CLP protocol will be Level IV. CLP data deliverables, documentation, and validation procedures will be followed.	Parameter identification confirmed.	CLP analyses reporting limits are specified in the SOW.

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Table 2-1
Sample Containers, Preservatives, and Holding Times

Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico

Analytical Fraction	Method	Matrix	Number of Containers	Container Size/Type	Preservative	Holding Time
Ground Water						
VOCs	SW846/8260B	water	3	40 mL, G	HCl, pH < 2, chill 4 degrees C	14 days
VOCs	CLP OLC 02.1	water	2	40 mL, G	HCl, pH < 2, chill 4 degrees C	14 days
VOCs	Field Portable Gas Chromatograph	water	1	40 mL, G	NA	ASAP
Soils						
VOCs	SW846/5035/8260B	soil	3	EnCore™	chill 4 degrees C	48 hours
			1	4 oz., G	chill 4 degrees C	48 hours
Soil Vapor						
VOCs	SW846/8021 mod.	gas	1	6L Summa Canister	NA	14 days
VOCs	TO-14	gas	1	Gas-tight syringe	NA	1 hour
Investigation-Derived Waste Characterization						
TCLP	SW846/1311	soil	1	NA	NA	NA
VOCs	SW846/8260B	soil	1	4 oz., G	chill 4 degrees C	14 day TCLP extr; 14 day analysis
SVOCs	SW846/8270C	soil	1	4 oz., G	chill 4 degrees C	14 day TCLP extr; 7 day extr; 40 day analysis
RCRA Metals	SW846/6010B/7470A	soil	1	4 oz., G	chill 4 degrees C	6 month TCLP extr ;6 month analysis, Hg: 28 day TCLP extr; 28 day analysis
Pesticides	SW846/8081A	soil	1	4 oz., G	chill 4 degrees C	14 day TCLP extr; 7 day extr; 40 day analysis
Herbicides	SW846/81511A	soil	1	4 oz., G	chill 4 degrees C	14 day TCLP extr; 7 day extr; 40 day analysis
Ignitability	SW846/1030	soil	1	4 oz., G	chill 4 degrees C	ASAP
Corrosivity	SW846/9045C	soil	1	4 oz., G	chill 4 degrees C	ASAP
Reactivity	SW846/Chapter 7	soil	1	4 oz., G	chill 4 degrees C	ASAP

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Table 2-2

Analytical Methods

*Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico*

Method	Parameter	Level of Analysis	Sample Matrix	Laboratory
Ground Water Sampling				
CLP Organics (OLC03.2)	Low Concentration VOCs	Level IV	Water	CLP Lab
SW846/9040B	pH	Level I	Water	Field Measurement
SW846/9050	Conductance	Level I	Water	Field Measurement
E170.1	Temperature (water)	Level I	Water	Field Measurement
E360.1	Dissolved Oxygen	Level I	Water	Field Measurement
	Oxidation-Reduction			
ASTM D1498	Potential	Level I	Water	Field Measurement
Photovac Voyager GC	VOCs	Level I	Water	Field Measurement
SW846/8260B	VOCs	Level I	Water	Close-Support Lab
Soil Sampling				
SW846/5035/8260B	VOCs	Level IV	Soil	CLP Lab
Soil Vapor Sampling				
SW846/8021A modified	VOCs	Level III	Gas	Close-Support Lab
EPA TO-14	VOCs	Level III	Gas	Off-site Subcontracted Lab
Soil IDW Characterization				
	Toxicity Characteristic			
SW846/1311	Leaching Procedure	Level III	Soil	Off-site Subcontracted Lab
SW846/8260B	VOCs	Level III	Soil	Off-site Subcontracted Lab
SW846/8270C	SVOCs	Level III	Soil	Off-site Subcontracted Lab
SW846/8081A	Pesticides	Level III	Soil	Off-site Subcontracted Lab
SW846/8151A	Herbicides	Level III	Soil	Off-site Subcontracted Lab
SW846/6010B/7470A	Metals	Level III	Soil	Off-site Subcontracted Lab
SW846/1030	Ignitability	Level III	Soil	Off-site Subcontracted Lab
SW846/9045C	Corrosivity	Level III	Soil	Off-site Subcontracted Lab
SW846/Chapter 7	Reactivity	Level III	Soil	Off-site Subcontracted Lab

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Table 2-3
Target Compound Lists and Reporting Limits

Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico

Target Compound	Reporting Limit			
	Groundwater (ug/L)	Soil Vapor (ug/L)	Leachate (ug/L)	Soil (mg/kg)
Water Volatile Organic Compounds (CLP Low-level method)				
1,1-Dichloroethane	0.5			
1,1-Dichloroethene	0.5			
1,2-Dichloroethane	0.5			
cis-1,2-dichloroethene	0.5			
trans-1,2-dichloroethene	0.5			
Tetrachloroethene	0.5			
Trichloroethene	0.5			
Vinyl chloride	0.5			
Soil Volatile Organic Compounds (for Modified SW846 Method 5035)				
1,1-Dichloroethane				0.010
1,1-Dichloroethene				0.010
1,2-Dichloroethane				0.010
cis-1,2-dichloroethene				0.010
trans-1,2-dichloroethene				0.010
Tetrachloroethene				0.010
Trichloroethene				0.010
Vinyl chloride				0.010
Soil Organic Vapor (by SW846 Method 8021A modified)				
1,1-Dichloroethane		1.0		
1,1-Dichloroethene		1.0		
1,2-Dichloroethane		1.0		
cis-1,2-dichloroethene		1.0		
trans-1,2-dichloroethene		1.0		
Tetrachloroethene		1.0		
Trichloroethene		1.0		

Table 2-3
Target Compound Lists and Reporting Limits

*Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico*

Target Compound	Reporting Limit			
	Groundwater (ug/L)	Soil Vapor (ug/L)	Leachate (ug/L)	Soil (mg/kg)
Soil Organic Vapor (by EPA Method TO-14A)				
1,1-Dichloroethane		0.1		
1,1-Dichloroethene		0.1		
1,2-Dichloroethane		0.1		
cis-1,2-dichloroethene		0.1		
trans-1,2-dichloroethene		0.1		
Tetrachloroethene		0.1		
Trichloroethene		0.1		
Vinyl chloride		0.1		
TCLP Volatiles				
Benzene			0.1	0.01
Butanone, 2-(Methyl ethyl ketone)			0.4	0.01
Carbon Tetrachloride			0.1	0.01
Chlorobenzene			0.1	0.01
Chloroform (trichloromethane)			0.1	0.01
Dichlorobenzene, 1,4-			0.1	0.01
Dichloroethane, 1,2-			0.1	0.01
Dichloroethene, 1,10			0.1	0.01
Tetrachloroethene			0.1	0.01
Trichloroethene			0.1	0.01
Vinyl Chloride			0.1	0.01
TCLP Semi-Volatiles				
Cresol			0.2	0.330
Dichlorobenzene, 1,4-			0.1	0.330
Dinitrotoluene, 2,4-			0.1	0.330
Hexachlorobenzene			0.1	0.330
Hexachlorobutadiene			0.1	0.330
Nitrobenzene			0.1	0.330
Pentachlorophenol			0.1	1.600
Hexachloroethane			0.01	0.330
Pyridine			0.01	0.330
Trichlorophenol, 2,4,5-			0.01	1.600
Trichlorophenol, 2,4,6-			0.01	0.330

Table 2-3
Target Compound Lists and Reporting Limits

Griggs and Walnut Ground Water Plume Site
Las Cruces, New Mexico

Target Compound	Reporting Limit			
	Groundwater (ug/L)	Soil Vapor (ug/L)	Leachate (ug/L)	Soil (mg/kg)
TCLP Pesticides				
Chlordane			0.020	0.0017
Endrin			0.002	0.0017
HCH, gamma-(BHC, gamma-) (Lindane)			0.002	0.0017
Heptachlor			0.002	0.0017
Heptachlor epoxide			0.002	0.0017
Methoxychlor			0.020	0.0033
Toxaphene			0.100	0.083
TCLP Herbicides				
2,4-D			0.002	0.7
2,4,5-TP (Silvex)			0.002	0.1
TCLP Metals				
Arsenic			0.1	2.0
Barium			5.0	40.0
Cadmium			0.2	1.0
Chromium (total)			0.5	1.0
Lead			0.5	0.6
Mercury (Inorganic)			0.0	0.1
Selenium			0.1	1.0
Silver			0.2	2.0

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Table 2-4 Instrument Calibration and Frequency <i>Griggs and Walnut Ground Water Plume Site</i> <i>Las Cruces, New Mexico</i>		
Instrument	Calibration Activity	Frequency
Dissolved Oxygen Meter	Calibrate to atmosphere	Beginning of each sampling day
Oxidation-Reduction Meter	Check ORP reading with a solution of known ORP (i.e. Zobell solution)	Beginning of each sampling day
pH Meter	Calibrate against standard pH solution (4.0 SU, 7.0 SU, and 10.0 SU)	Beginning of each sampling day
Specific Conductivity Meter	Check conductivity reading with a solution of known conductivity	Beginning of each sampling day
PhotoVac Voyager GC		

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Attachment A
**Standard Operating Procedure for the Analysis of
Volatile Organic Compounds by Voyager™ Portable Gas Chromatography**

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Attachment A

Standard Operating Procedure (version 1.0)

Analysis of volatile organic compound(s) by Voyagerä portable gas chromatography

Scope and Application

This standard operating procedure (SOP) is provisional in nature. The descriptions of the instrument, operating parameters, and other techniques used in producing analytical data is subject to modification as warranted by the unique nature of the particular instrument to be employed in this effort. This SOP does not presuppose that technicians have a working knowledge and experience in the operation of the Voyager portable gas chromatograph. Staff members performing the procedures described in this SOP are responsible for reading, understanding, and complying with the SOP's requirements. The purpose of this SOP is to describe the procedures for analysis of soil and soil sediments using the Voyager Portable Gas Chromatograph.

The Voyager can be operated from the instrument keypad or from the associated PC software called SiteChart LX. Once calibrated, the choice of operational mode (key pad or software) depends on sampling location. If power is available or samples are brought to the instrument, users continue to run the Voyager from SiteChart; and for field sampling applications, analysis runs are generally done from the keypad.

SITECHART INSTALLATION:

Installing to PCs or Laptops with Windows 3.1, 3.11 or NT 3.5.1

1. Close any open Windows applications.
2. Insert SiteChart PC Software Disk #1 in drive a:
3. Open Program Manager and select the File menu, the Run command.
4. Type *a:\setup* at the command line in the Run. Dialog box, then click *O.K.*
5. Follow subsequent prompts.

Installing to PCs or Laptops with Windows 95 or NT 4.0.

1. Close any open Windows applications.
2. Display the Task Bar. Click on the Start button, Settings icon, and then the Control Panel icon.
3. On the Control Panel, click on the Add/Remove Programs icon.
4. On the Add/Remove Programs Properties screen, click on the Install/Uninstall Tab, and then click on the install button.
5. At the Install Program from Floppy Disk or CD-ROM screen, insert SiteChart PC Software Disk #1 in

drive a:. Click on Next button.

6. In the *Command Line for Installation Box* type *setup.exe*.

7. Follow subsequent prompts.

INSTRUMENTATION SETUP

1. Prior to instrument operation, fill the internal cylinder with carrier gas (ultra pure air or nitrogen) or connect the instrument to an external supply of carrier gas
2. Ensure the battery is charged or that the instrument is connected to the AC adapter.
3. Press the Instrument **On/Off** Key to turn on the Voyager. The software version and copyright notice will be displayed.
4. Review the instrument status by hitting the **Enter/Menu** key, then **Display**, then **Status**. Use the up and down arrow keys to scroll through the status information. Several of the key status parameters are as follows:
 - PID Signal ~ 2 mV (if in high sensitivity mode)
~ 200 mV (if in low sensitivity mode)
 - PID Offset ~ 300 – 800 mV (if in high sensitivity mode)
~ 2 mV (if in low sensitivity mode)
 - PID UV Int. ~ 300 – 800 mV
 - PID Status ONNote: If the Voyager PID parameters are not as specified above, do not continue with analyses.

ENSURING COMMUNICATION:

1. Open SiteChart by clicking on Start, then Programs, then Photovac SiteChart, and then SiteChart. or double click on SiteChart Icon.
2. Connect communication cable from Voyager to PC or Laptop.
3. Click on Instrument Tab
4. Note the “Start” button located on the right, lower part of this window. If it says “Start/Stop”, the Voyager and SiteChart are not communicating. Also note the white instrument status box above the “Start” button. Real-time updates should occur in the status box.
5. If Voyager and SiteChart are NOT communicating:
 - a. Click on “Communications” (in title bar), then Setup. This opens dialog box “Com Setup”. Change the communication port from COM1 to COM2 OR from COM2 to COM1 .
 - b. Check the computer cable is firmly attached to the Voyager and none of the pins are bent.
6. When communication is connected, within a minute the button will say “Start” and the method parameters (temperature, pressure, etc.) will be displayed in the status schematic in the upper right hand corner of the screen. Real-time updates should occur in the white instrument status box.

VOYAGER SETUP FROM SITECHART

1. Open the SiteChart software
2. Open the appropriate Assay file (*.App)
 - Click on **Assay Tab** in SiteChart
 - Go to **File, Open**
 - Find the Assay file in appropriate directory: c:\program files\sitechart\data\voyagerserial#\methodname.app

Note: The factory-developed assay will initially need to be loaded from the disk shipped with the instrument.
3. Connect Voyager to serial port on the computer with the RS232 communication cable
4. Verify communication between Voyager and computer
 - Go to **Instrument Tab** in SiteChart, bottom right button will say “start”, not “start/stop” and status information will continuously update if communication is established
 - If communication is not established, check **Communications, Setup, Port**
5. Define Assay Parameters for the Column
 - Go to **Assay Tab** in SiteChart
 - Select **Column/Detector** (e.g. A-PID); then click on the **Config** button
 - Verify detector is enabled. The ECD and/or PID state will be *disabled* if detector is off or *low/high sensitivity* if detector is on
 - Verify Sampling method (loop or syringe). Click the **Inject** button; ensure desired sampling mode is selected; either loop or syringe
 - Click **O.K.** to leave config mode
 - Verify Compound information in the library. Highlight each compound folder in the library list and ensure:
 - Cal Compound** box is checked
 - Cal Concentration** value is entered correctly

Note: Check Cal Compound box ONLY if compound is contained in the calibration gas
6. When assay parameters have been verified, send assay information to the Voyager
 - Click on **Send to Voyager** button

VOYAGER BASIC FUNCTIONAL TESTS:

1. Make sure the instrument is plugged in or fully charged.
2. Fill internal carrier gas reservoir.
 - a. Connect the carrier gas refill adapter to a cylinder of carrier gas.
 - b. Open the main gas valve, then briefly open the refill adapter (black) valve to purge the line
 - c. Connect the quick-connect fitting to the Carrier In port on the Voyager
 - d. Open the black valve filling the cylinder to ~1500psi—not more than 1800psi.
 - e. **NOTE: This should last ~7-8hrs so monitor the consumption over the day.**
3. Turn on the Voyager.
 - a. The PID lamp will tune automatically. It takes ~2-3 minutes.

- b. Push the white Enter/Menu key. Then press the red key above the word *Display*, then *Status*
- c. *Fault: Oven Not Ready* will appear until the oven reaches the preprogrammed temperature—usually ~60 °C.
- d. When the oven temperature and carrier gas flow rate reach the set values, *Ready* will be displayed in the corner and green Ready LED will come on.
- 4. Check the Voyager Status
 - a. PID Signal = ~2 mV
 - b. PID Offset = 300 – 800 mV (If >800 mV, monitor to see if it decreases)
 - c. PID UV Intensity = 300 – 800 mV
 - d. PID Status = On (Quickly turn instrument on then off if PID Status = On/Reset)

RUN A BLANK SAMPLE

- 1. Go to **Instrument Tab** in SiteChart
 - 2. Confirm desired column is selected. Go to **Analyze, Column**, then click on desired column (yellow line of instrument diagram should lead to desired column)
 - 3. Set tag. Go to **Analyze, Setup**; type tag
 - 4. Click **Start** button
- Note: Ambient air will be drawn in for a ‘blank’ loop sample or an air blank injection can be done to simulate a clean headspace injection*

Assay Development

Each pre-programmed assay contains one compound library per column/detector pair. The library information is based upon the standard assay parameters. If a modification is made to the method (e.g. pressure or temperature change), compound retention times will shift and a new library needs to be created. *This is accomplished by running the compounds with the current method conditions, then adding them to the library. A similar concept applies to the development of a unique assay. A chromatogram must be obtained for each compound of interest then added to the library.* Note: SiteChart LX is required for assay development.

ANALYSIS SETTINGS

Developing the method allows optimization of the system for the particular application. If, for example, your objective is to run BTEX as quickly as possible, you will want to set a higher pressure (flow rate) or temperature than the standard parameters. This will shorten the BTEX retention times. If your goal is to resolve two peaks with similar retention times, the pressure and temperature should be lowered. This may increase the resolution of the compound peaks.

The purpose of following steps (1-7) is to obtain a chromatogram of each analyte of interest under the desired method conditions. One chromatogram containing a peak of for each compound is also very acceptable.

- 1. Open the SiteChart LX software
- 2. Open the Assay (method) file (*.App) to be modified

- Click on **Assay Tab**
- Go to **File, Open** Find Assay file in appropriate directory: c:\program files\sitechart\data\voyagerserial#\ *methodname.app*

OR

Open a new assay to be created

- Click on **Assay Tab**
- Go to **File, New**

3. Define Assay parameters for the column to be used for analysis.

Go to **Assay Tab**

Select **Column/Detector** (e.g. A-PID); then click on the **Config** button

- Enter an Analysis Time
 - Enter an Oven Temperature
 - Enter an ECD Oven Temp. (generally, same as Oven Temp., even if ECD is not in use)
 - Select ECD State (disabled, low or high sensitivity)
 - Select PID State (disabled, low or high sensitivity)
 - Click the **Inject** button; to select desired *sampling mode* and to set the *Backflush Time*
 - If selecting loop; Enter inject time and pump time
 - If selecting syringe; Enter syringe volume
 - Enter Backflush Time
 - Click **O.K.**
 - Click **O.K.** again to leave config mode
 - Repeat for other Column/Detector pairs
4. When assay parameters have been verified, send assay information to the Voyager
- Click on **Send to Voyager** button
5. Run a chromatogram of the compound of interest.
- Go to **Instrument Tab**
 - Confirm desired column is selected
 - Go to **Analyze, Column**, then click on desired column
(yellow line of instrument diagram should lead to desired column)
 - Set tag
 - Go to **Analyze, Setup**; type tag
6. Click **Start** button
7. **Repeat steps 5-6** for each analyte of interest
- The purpose of this step is to Add the compound information to the library for the appropriate column/detector pair.***
8. Determine the file names of each chromatogram containing a compound you wish to add to the library.
- Click on the **Log Review Tab**
 - Note the file name(s) of the appropriate chromatogram(s)

- If you cannot find the chromatograms of the samples you ran, ensure you are looking in the appropriate directory c:\program files\sitechart\data\voyager\serial#\methodname.app

9. Add Compounds to the Library

- Go to **Assay Tab**
- Select the **Column/Detector** to which the compound(s) will be added to the library
- Go to **File, Open**
- Open the file for the compound(s) to be added to the library
- Integrate the chromatographic peaks
(see SiteChart LX manual for explanation of integration parameters)
- Click the **Add** button
- Enter the Compound Name
- Enter the Peak Number
- Enter the Concentration (estimate if unsure; an accurate known concentration is only necessary when calibrating)

If the chromatogram contains additional peaks of compounds to be added to the library, click **Add** button again and repeat.

If other compounds of interest were analyzed in separate analyses, go to **File, Open** and repeat

10. Save the New Assay

- Go to **File, Save**

11. Run analyses using new Assay

- Go to **Assay Tab**
- Enter necessary information to Calibrate the method
- Click on **Send to Voyager** button
- Run Calibration Standard
- Calibrate
- Begin Analyses

Calibration Gases:

Gas standards for the Voyager GC may be purchased from any major specialty gas supplier or prepared from pure compounds by the user. Choose a standard containing the target gas or mix of gases.

Ratiometric Calibration

While it is STRONGLY recommended that Voyager be calibrated using a calibration mix that contains every compound in the column's library, it is possible to calibrate the Voyager using a calibration mixture containing only a few of the compounds in the column library. A calibration, performed with a calibration mix that does not contain all the library's compounds, is called a ratiometric calibration.

PROCEDURE

This ratiometric calibration procedure assumes that method and library development are complete. Using the SiteChart LX software, select **Assay Tab**. Under Column/Detector just to the left of the “Send to Voyager” button, choose the Column and Detector pair that will be calibrated.

Select the first compound in the library for that column. On the right side of the screen near the top you will see the name of the compound selected and a box with words CAL COMPOUND to the right. If that compound is in the calibration mixture, the box must be checked. At this time, verify that the cal concentration matches the concentration of the compound in your calibration standard. If that compound is not in the calibration mix, the box must be unchecked. Repeat this procedure for all the compounds in that column/detector library. After this step is complete, only the compounds in the calibration mixture should have a check in the CAL COMPOUND box.

Next, select **Instrument Tab**. Run the calibration gas mixture on the Voyager. After the run is completed, select **Analyzer** from the Menu bar at the top of the screen. Next select **Calibrate** from the Analyzer menu. The Voyager will then calibrate itself based on the previous chromatogram of the calibration gas mixture. The Voyager will flash a Calibration Fault message on the unit’s LCD screen. This is normal after a ratiometric calibration. This message will flash continuously on the Voyager’s LCD until power is cycled or the Voyager is recalibrated for the complete library. A calibration can also be done from the Voyager’s soft keys once the calibration library has been modified using SiteChart LX.

After a ratiometric calibration, the Voyager’s compound library will be correctly updated for the compounds and concentrations present in the calibration mixture. Voyager will ratiometrically approximate the retention times and concentrations settings for the compounds that were not present in the calibration mixture. This approximation may affect compound identification and the accuracy of the compound concentration reported by Voyager. The Voyager’s best accuracy is obtained by performing a complete calibration on each compound in your libraries at least once every **four** hours of instrument usage.

Assay # 1 Typical Detection Ranges for Volatile Organic Compounds (VOCs) in Ambient Air

The Voyager utilizes a PID and ECD for the detection of VOCs in the **PPB and PPM** concentration range. Following is a typical detection range determined for the compound in Voyager Assay #1 when monitoring for VOCs in ambient air.

The Assay #1 typical detection range was calculated for Tetrachloroethylene in Assay # 1 using the analytical method (column temperature, carrier gas flow rate) set by the Assay 1 files (programmed at Photovac). This detection range is estimated based on the ability of the Voyager to detect the compound under actual field sampling conditions. Voyager typical detection ranges are affected by field conditions,

undesired compounds in the sample stream, possible coelutions, calibration accuracy, training of the Voyager operator and condition of the Voyager instrument. Instrument conditions that affect typical detection ranges include contamination of the PID lamp window, age of the PID lamp and oxygen content of the carrier gas which can contaminate the ECD.

Voyager Portable GC PID Typical Detection Ranges for Assay # 1

Column B TYPICAL DETECTION RANGE (PPM)

<u>Analyte</u>	<u>Range</u>
Tetrachloroethylene	0.01-35

Procedure for Preparing Soil Samples for Analysis

When analyzing samples with a field portable Gas Chromatograph, rapid turn-around, simplicity of operation and data reproducibility are very important. Therefore the method of injection and sample preparation must be carefully thought out. Static headspace methods allow soil samples to be analyzed in the field with speed and accuracy without using expensive sample preparation equipment. "Static headspace involves a partitioning of volatile components between the aqueous and vapor phases enclosed in a gas tight vial" ¹. The gas chromatograph is capable of analyzing static headspace above soil samples. Following is the procedure for preparing soil samples for analysis by the Voyager Portable Gas Chromatograph. The Encore™ device can be used in place of the modified plastic syringes. Each Encore™ will provide 5 gm of sample and would probably be a more practical application.

EQUIPMENT NEEDED

- 40 mL VOA vials with Teflon septum caps
- 10 cm³ plastic syringes
- Graduated cylinder or volumetric pipettes
- Gas tight syringes
- Spare needle
- Constant temperature water bath
- Distilled water

SOIL SAMPLES

Using a sharp knife cut the injection tip off a 10 cm³ plastic syringe. Use the 10cm³ tipless plastic syringe to collect 4cc of soil ³, allowing the open end to core the soil (4cc = approx.

5-7 gm). Clean the outside of the plastic syringe with a paper towel to remove soil particles.

Insert the plastic syringe into a 40 mL VOA vial containing 20 mL of distilled, organic-free water. Push the plunger down to extrude all of the soil from the syringe.³

Optional Step - To determine the exact concentration of the compound(s) in the soil, the soil sample will have to be weighed and the exact weight noted for use in the calculation found below. The best method of weighing the soil is to weigh the vial with the organic-free water, add the soil and reweigh. If soil weight is not known, an estimate will have to be made.

Immediately cap the vial and shake vigorously for two minutes.

Before samples are analyzed the portable gas chromatograph should be calibrated with an aqueous standard containing all of the compounds of interest. The standard should be handled in exactly the same fashion as the samples, using the identical volume of headspace, the identical injection volume, and the identical equilibration time and temperature.

Place the inverted vials into a constant temperature water bath for fifteen minutes for thermal equilibrium to be reached. The temperature of the water bath should be 30...C.

When ready to analyze, remove a suitable amount of headspace to inject into the GC using a gas tight syringe. Typically, injection volumes of headspace range from 100-500 uL.

During analysis the sample is compared to the library compounds. Sample constituents will be identified and quantified based on comparison with the library. Since the library used was created with aqueous standards (weight/volume), a calculation is required to determine the soil concentration (wt/wt).

CALCULATION

Determine the concentrations of individual compounds in the sample by using the following formula derived from the EPA SOP #2109, modified for use with the Voyager Portable Gas Chromatograph 4:

$$\text{Sample Conc.} = \frac{\text{Instrument reported value} \times \frac{\text{Standard Volume (Syringe Vol for Calib.)}}{\text{Injected Vol. (vol of Sample in Syringe)}} \times \frac{\text{Volume Water (mL) in vial}}{\text{Mass Soil (gm), Actual}}}{\text{Weight}}$$

Soil Sample Concentration in PPM (mg/kg) or PPB (ug/kg)

Voyager reported Concentration in PPM or PPB

Volume of Organic-Free Water Added to Sample Vial in mL (usually 20 mL)

Mass of Soil Sample in gm

Maintenance and Calibration Schedule

<u>Function</u>	<u>Frequency</u>
Battery charge when instrument has been operating off internal batteries	Charge unit after every 8 hours of use. Refer to operating manual
Calibration (Initial)	Initial calibration performed day of use.
Calibration (Continuing)	Every four (4) hours

Septum Change

Approximately 40 injections

All maintenance and calibration functions must be documented.

Troubleshooting Guide

<u>Problem</u>	<u>Probable Cause</u>	<u>Remedy</u>
1. no chromatographic response	no Carrier gas flow batteries not functional	check flow/pressure gauge plug into AC and check again
2. baseline drift	unit subjected to large temperature change high concentration sample has recently introduced carrier gas contamination	allow GC to stabilize purge GC with blanks until clear change carrier gas supply
3. deterioration of sensitivity	syringe has leak at plunger column needs conditioning septum leaking column fitting leak	new syringe condition column (refer to operating manual) change septum refer to operating manual
4. low frequency noise displayed on chromatograph	column needs conditioning	condition column
5. peaks elute slowly	carrier flow rate is too slow	increase flow rate
6. peaks elute to fast	carrier flow rate is too fast	decrease flow rate
7. peak has flat top	detector is saturated	lower injection volume or pre-dilute sample and repeat
8. peak is asymmetric with tailing	improper injection carrier flow rate is too slow analyte match to wrong column power supply inadequate	repeat increase flow rate re-select column charge batteries or go to AC
9. detector does not return to zero	detector saturated	allow carrier flow for extended period without sample injection

Safety

Class I, Division I, Groups A, B, C, & D

Zone I locations, Eex ib m IICT4, Demko No. 97D 121 971

References

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³ Collection, handling and storage: Keys to improved data quality for volatile organic compounds in soil. Hewitt,

A.D., T.F. Jenkins and C.L. Grant. American Environmental Laboratory, On-Site Analysis February 1995.

⁴ Compendium of ERT Field Analytical Procedures. United States EPA, Office of Emergency and Remedial Response, Washington, DC. Publication 9360.4-04 May 1992.

⁵ Photovac Corporation Technical Tips on operation of Voyager Portable Gas Chromatograph. 2002

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Attachment B
**CLP Sample Collection Guidelines for
Volatiles in Soil by CLP-Modified SW-846 Method 5035**

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CLP Sample Collection Guidelines for Volatiles in Soil by CLP-Modified SW-846 Method 5035 FOR Encore™ 2000

Collect the following:

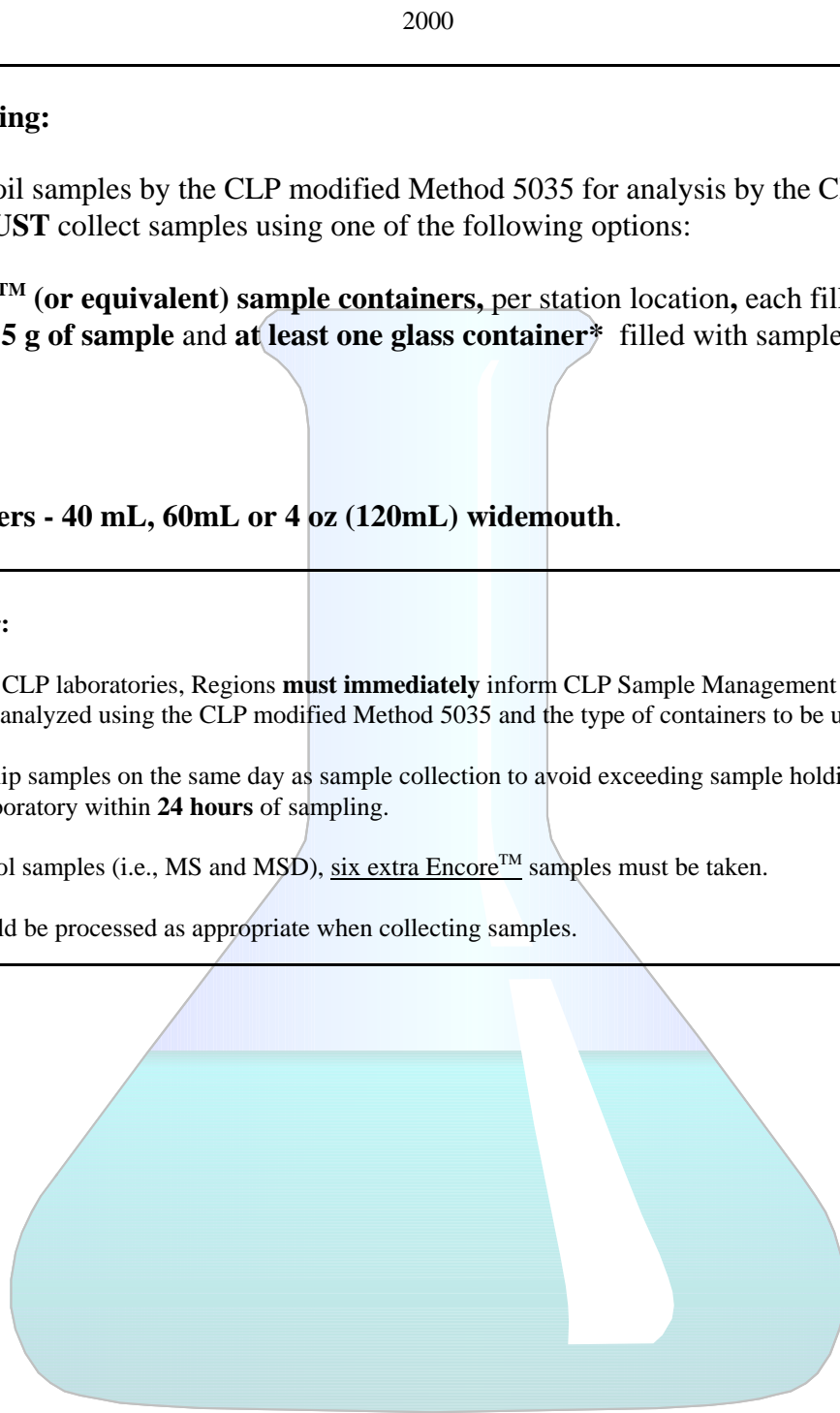
When collecting soil samples by the CLP modified Method 5035 for analysis by the CLP SOW OLM04.2, you **MUST** collect samples using one of the following options:

- 1.) **Three Encore™ (or equivalent) sample containers**, per station location, each filled with approximately **5 g of sample** and **at least one glass container*** filled with sample with no headspace.

*** - Glass Containers - 40 mL, 60mL or 4 oz (120mL) widemouth.**

Things to Remember:

- When scheduling CLP laboratories, Regions **must immediately** inform CLP Sample Management Office coordinators if samples are to be analyzed using the CLP modified Method 5035 and the type of containers to be used.
 - Samplers **must** ship samples on the same day as sample collection to avoid exceeding sample holding times. All samples must reach the laboratory within **24 hours** of sampling.
 - For quality control samples (i.e., MS and MSD), six extra Encore™ samples must be taken.
 - Field blanks should be processed as appropriate when collecting samples.
-



Useful Sample Collection Information (by Sample Container)

2000

Option 1

Encore™ (or equivalent) Sample Containers

Sample Amount: 5 grams

Preservative: N/A

Storage: Cool to 4EC immediately after collection.

Shipping: Must reach laboratory within 24 hours.

Sample Labeling: Legibly print the sample number on the detachable label provided with the Encore™ bag, and attach to the Encore™ container. Apply any labels with additional information, as specified by the Region, on the EnCore™ bag.

Custody Seal: Initial the custody seal and place over the top of the closed EnCore™ bag in such a manner that the bag cannot be opened (even partially) and the contents removed. Two or three seals may need to be used. **Do not place custody seals directly on the Encore™ sample container.**

Sample Tag: The sample tag should be secured to the bag after the EnCore™ sample container has been placed inside. This can be done using tape, or other methods, provided that the sample tag is securely fastened to the bag and will not become dislodged in transit.

Attachment C
Descriptions of Methods

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SW8081A-Organochlorine Pesticides

Organochlorine pesticides in water and soil samples are analyzed using method SW8081A. This analytical method involves the extraction of the samples. The pesticides are then separated and quantified by GC using electron capture detection. Reporting limits (RLs) for this method are presented in the following table. The calibration, QC, corrective action, and data flagging requirements are given in the following tables.

TABLE C-2.A
RLs for Method SW8081A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Organochlorine	α -BHC	0.0135	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
Pesticides	β -BHC	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
SW8081A	δ -BHC	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	γ -BHC (Lindane)	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	α -Chlordane	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	γ -Chlordane	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	4,4'-DDD	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	4,4'-DDE	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	4,4'-DDT	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Aldrin	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	Dieldrin	0.00532	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Endosulfan I	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	Endosulfan II	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Endosulfan Sulfate	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Endrin	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Endrin Aldehyde	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Endrin Ketone	0.1	$\mu\text{g/L}$	3.3	$\mu\text{g/kg}$
	Heptachlor	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	Heptachlor Epoxide	0.05	$\mu\text{g/L}$	1.7	$\mu\text{g/kg}$
	Methoxychlor	0.5	$\mu\text{g/L}$	17	$\mu\text{g/kg}$
	Toxaphene	3	$\mu\text{g/L}$	170	$\mu\text{g/kg}$

TABLE C-2.B
QC Acceptance Criteria for Method SW8081A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW8081A	α -BHC	75–125	≤ 30	65–135	≤ 50
	β -BHC	51–125	≤ 30	41–133	≤ 50
	δ -BHC	75–126	≤ 30	65–136	≤ 50
	γ -BHC (Lindane)	73–125	≤ 30	63–130	≤ 50
	α -Chlordane	41–125	≤ 30	31–135	≤ 50
	γ -Chlordane	41–125	≤ 30	31–133	≤ 50
	4,4-DDD	48–136	≤ 30	38–146	≤ 50
	4,4-DDE	45–139	≤ 30	35–149	≤ 50
	4,4-DDT	34–143	≤ 30	25–153	≤ 50
	Aldrin	47–125	≤ 30	37–126	≤ 50
	Dieldrin	42–132	≤ 30	32–142	≤ 50
	Endosulfan I	49–143	≤ 30	39–153	≤ 50
	Endosulfan II	75–159	≤ 30	65–169	≤ 50
	Endosulfan Sulfate	46–141	≤ 30	36–151	≤ 50
	Endrin	43–134	≤ 30	33–144	≤ 50
	Endrin Aldehyde	75–150	≤ 30	65–160	≤ 50
	Heptachlor	45–128	≤ 30	35–138	≤ 50
	Heptachlor Epoxide	53–134	≤ 30	43–144	≤ 50
	Methoxychlor	73–142	≤ 30	63–152	≤ 50
	Toxaphene	41–126	≤ 30	31–136	≤ 50
	Surrogates:				
	DCBP	34–133		25–143	
	TCMX	45–125		35–135	

Method SW8260B-Volatile Organics

Volatile (or purgeable) organics in water and soil samples are analyzed using method SW8260B. This method uses a capillary column GC/mass spectrometry technique. Volatile compounds are introduced into the GC by purge and trap (SW5030B or SW5035). An inert gas is bubbled through the water samples (or a soil-water slurry for soil samples) to transfer the purgeable organic compounds from the liquid to vapor phase. Soil samples with higher contaminant levels are extracted using methanol before purging. The vapor is then swept through a sorbent trap where the purgeable organics are trapped. The trap is backflushed and heated to desorb the purgeable organics onto a capillary GC column where they are separated and then detected with a mass spectrometer. The analytes detected and RLs (using a 25 mL purge) for this method are listed in the following table.

Calibration—The mass spectrometer is tuned daily to give an acceptable spectrum for BFB. The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass (alternatively, other documented tuning criteria may be used (e.g., CLP, Method 524.2, or manufacturer's instructions), provided that method performance is not adversely affected):

- mass 5015 percent to 40 percent of mass 95
- mass 7530 percent to 60 percent of mass 95
- mass 95base peak, 100 percent relative abundance
- mass 965 percent to 9 percent of mass 95
- mass 173 less than 2 percent of mass 174
- mass 174 greater than 50 percent of mass 95
- mass 175 5 percent to 9 percent of mass 174
- mass 176 greater than 95 percent, but less than 101 percent of mass 174
- mass 177 5 percent to 9 percent of mass 176

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in the following tables.

TABLE C-4.A
RLs for Method SW8260B

Parameter/Method	Analyte	Water RL	Unit	Soil RL	Unit
VOCs	Chloromethane	1	µg/L	10	µg/kg
SW8260B	Bromomethane	1	µg/L	10	µg/kg
	Vinyl Chloride	1	µg/L	10	µg/kg
	Chloroethane	1	µg/L	10	µg/kg
	Methylene Chloride	2	µg/L	5	µg/kg
	Acetone	5	µg/L	10	µg/kg
	Carbon Disulfide	1	µg/L	5	µg/kg
	1,1-Dichloroethene	1	µg/L	5	µg/kg
	1,1-Dichloroethane	1	µg/L	5	µg/kg

Parameter/Method	Analyte	Water RL	Unit	Soil RL	Unit
	1,2-Dichloroethene (Total)	1	µg/L	5	µg/kg
	cis- 1,2-Dichloroethene	1	µg/L	5	µg/kg
	trans-1,2-Dichloroethene	1	µg/L	5	µg/kg
	Chloroform	1	µg/L	5	µg/kg
	1,2-Dichloroethane	1	µg/L	5	µg/kg
	2-Butanone	5	µg/L	10	µg/kg
	1,1,1-Trichloroethane	1	µg/L	5	µg/kg
	Carbon tetrachloride	1	µg/L	5	µg/kg
	Vinyl Acetate	5	µg/L	10	µg/kg
	Bromodichloromethane	1	µg/L	5	µg/kg
	1,2-Dichloropropane	1	µg/L	5	µg/kg
	Cis-1,3-Dichloropropene	1	µg/L	5	µg/kg
	Trichloroethene	1	µg/L	5	µg/kg
	Dibromochloromethane	1	µg/L	5	µg/kg
	1,1,2-Trichloroethane	1	µg/L	5	µg/kg
	Benzene	1	µg/L	5	µg/kg
	Trans-1,3-Dichloropropene	1	µg/L	5	µg/kg
	Bromoform	1	µg/L	5	µg/kg
	2-Hexanone	5	µg/L	10	µg/kg
	4-Methyl-2-pentanone	5	µg/L	10	µg/kg
	Tetrachloroethene	1	µg/L	5	µg/kg
	1,1,2,2-Tetrachloroethane	1	µg/L	5	µg/kg
	Toluene	1	µg/L	5	µg/kg
	Chlorobenzene	1	µg/L	5	µg/kg
	Ethylbenzene	1	µg/L	5	µg/kg
	Styrene	1	µg/L	5	µg/kg
	Xylenes (Total)	1	µg/L	5	µg/kg

TABLE C-4.B
QC Acceptance Criteria for Method SW8260B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS
SW8260B	1,1,1-TCA	75–125	≤ 20	65–135	≤ 30	1
	1,1,2,2-Tetrachloroethane	74–125	≤ 20	64–135	≤ 30	3
	1,1,2-TCA	75–127	≤ 20	65–135	≤ 30	1
	1,1-DCA	72–125	≤ 20	62–135	≤ 30	1
	1,1-DCE	75–125	≤ 20	65–135	≤ 30	1
	1,2-DCA	68–127	≤ 20	58–137	≤ 30	1
	1,2-Dichloroethene (Total)	75-125	≤ 20	65-135	≤ 30	
	1,2-Dichloropropane	70–125	≤ 20	60–135	≤ 30	1
	2-Butanone	50-150	≤ 20	50-150	≤ 30	
	2-Hexanone	50-150	≤ 20	50-150	≤ 30	
	4-Methyl-2-pentanone	50-150	≤ 20	50-150	≤ 30	
	Acetone	50-150	≤ 20	50-150	≤ 30	
	Benzene	75–125	≤ 20	65–135	≤ 30	1
	Bromodichloromethane	75–125	≤ 20	65–135	≤ 30	1
	Bromoform	75–125	≤ 20	65–135	≤ 30	2
	Bromomethane	72–125	≤ 20	62–135	≤ 30	1
	Carbon Disulfide	50-150	≤ 20	50-150	≤ 30	
	Carbon Tetrachloride	62–125	≤ 20	52–135	≤ 30	1
	Chlorobenzene	75–125	≤ 20	65–135	≤ 30	2
	Chloroethane	65–125	≤ 20	55–135	≤ 30	1
	Chloroform	74–125	≤ 20	64–135	≤ 30	1
	Chloromethane	75-125	≤ 20	65–135	≤ 30	1
	Cis-1,2-DCE	75–125	≤ 20	65–135	≤ 30	1
	Cis-1,3-Dichloropropene	74–125	≤ 20	64–135	≤ 30	1
	Dibromochloromethane	73–125	≤ 20	63–135	≤ 30	2
	Ethylbenzene	75–125	≤ 20	65–135	≤ 30	2

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc. IS
	Methylene chloride	75–125	≤ 20	65–135	≤ 30	1
	Styrene	75–125	≤ 20	65–135	≤ 30	2
	Tetrachloroethene	71–125	≤ 20	61–135	≤ 30	2
	Toluene	74–125	≤ 20	64–135	≤ 30	1
	Trans-1,2-DCE	75–125	≤ 20	65–135	≤ 30	1
	Trans-1,3-Dichloropropene	66–125	≤ 20	56–135	≤ 30	
	Trichloroethene	71–125	≤ 20	61–135	≤ 30	1
	Vinyl Acetate	50–150	≤ 20	50–150	≤ 30	
	Vinyl Chloride	46–134	≤ 20	36–144	≤ 30	1
	Xylenes, total	75–125	≤ 20	65–135	≤ 30	2
Surrogates:						
	Dibromofluoromethane	75–131		65–135		
	Toluene-D8	68–125		65–135		
	4-Bromofluorobenzene	75–125		65–135		
	1,2-DCA-D4	62–139		52–149		
Internal Standards:						
	Fluorobenzene					1
	Chlorobenzene-D5					2
	1,4-Dichlorobenzene-D4					3

Additional Guidance on the use of Method 5035.

The intent of Method 5035 is to collect the sample causing the least amount of disturbance to the soil structure and to transfer and seal the sample in a sample container with a hermetic seal. From the time of collection until after the analysis, the sample container remains unopened. The issues discussed in this document are intended to supplement the method in order to resolve and clarify some technical issues. For all procedures not specified in this document, the procedures specified in Method 5035 for sample collection, sample preparation, and sample analysis should be followed. The option to collect a bulk sample for quantitative analysis (Method 5035, sections 2.2.1 and 6.2.3) is not allowed. All samples for quantitative analysis must be collected using a coring device and must be either transferred in the field to a 40-mL vial

which is then hermetically sealed, or the sample can be hermetically sealed in the sampling device. Method 5035 includes procedures for preparing low concentration samples (expected to contain VOCs between 5-200 ug/Kg) and high concentration samples (expected to contain greater than 200 ug/kg). Samples and/or media can be screened in the field using an organic vapor monitor (OVM) or other appropriate field instrument, and in the laboratory using a gas chromatography screening method, be conducted prior to selecting either the low or high concentration option for samples.

The recommended method of sample collection for both low and high concentration soils is to collect the sample using a coring device and to quickly extrude the sample core into a tared 40-mL vial that does not contain preservative but does contain the stir bar. The vial is quickly sealed and chilled, held at 4°C, and shipped to the laboratory. The vial remains unopened until after the analysis is complete. This collection procedure does not require the use of preservatives in the field or balances in the field.

1. Sample vials should be prepared in a fixed laboratory or other controlled environment. The tare weight of the sample vial including cap, septum, stir bar (if applicable), and the label, must be determined and recorded on the label prior to shipping the vials to the field for sample collection.
2. All samples for quantitative must be collected using a coring device and must be either transferred in the field to a 40-mL VOA vial which is then hermetically sealed, or the sample can be hermetically sealed in the sampling device.
 - a. Several devices are available commercially; however for this project the The EasyDraw Syringe™ and Powerstop Handle™ or equivalent will be used. (US Analytical Laboratory, 800-490-5092), www.usoil.com/lab)
 - b. The sample size collected should be approximately 5 grams. The coring device should be calibrated and be designed to minimize the disturbance of the sample during collection.
 1. A new device must be used for the collection of each new sample. The coring device can be used to collect multiple aliquots from the same sample point provided the integrity of the coring device is not compromised.
 2. Insert a cutoff syringe into the syringe holder.
 3. Push the syringe into the soil until the plunger strikes the stopper on the syringe holder.
 4. Remove the syringe and expel soil sample into the appropriate sample container. A jar for the bulk sample and three (seven if MS/MSD is required) tared 40-mL VOA vials (containing a stir bar) should be collected.
 5. For non-cohesive samples, the 5-gram sample should be quickly transferred into the 40-mL vial using a spatula.
 6. The threads of the vial are inspected and wiped clean.
 7. Screw cap firmly on vial.

-
8. Vials are placed in plastic bags.
 9. The plastic bags containing the sample vials are sealed and placed on ice and submitted to the laboratory.
 - c. A bulk sample should be collected using the coring device and placed in a 4-ounce jar. This sample should be used for screening purposes in the laboratory, but not for quantitative analysis. After screening, the remaining contents of the sample jar may be used to determine the percent moisture, to check reactivity with sodium bisulfate (if the laboratory chooses to preserve the sample), and/or determine the appropriate extraction solvent, if necessary.
 - d. For low-level option, the entire sample is consumed during the analysis; therefore, a total of three samples (in addition to the bulk sample) will be collected at each sample point. This provides one sample for the analysis, one sample in case a dilution is required (methanol extraction), and one sample for reanalysis, if necessary.
 - e. If the sample point is to be used for the MS/MSD sample, the sample point should be representative of the sample matrix in a location where the level of contamination is expected to be at or near the regulatory limit. For low concentration soils, four additional samples should be collected from this sample point for a total of seven samples.
 - f. The use of sodium bisulfate in the field as a preservative is not recommended. Its use is limited to non- or low -calcareous soil samples (i.e., samples that do not effervesce when mixed with a sodium bisulfate solution).
 3. The laboratory must measure and record the weight of the sample vial after receipt. The actual weight of the sample will be used for quantitation of results.
 4. The integrity of the seal on the vials should be checked and any problems documented. Improperly sealed samples should not be used for analysis. If an integrity problem with the seal is discovered after the analysis of a sample, the results should be flagged as estimated low and the project contact should be notified immediately.
 5. All samples must be held sealed 40-mL vials at 4°C and analyzed within the holding times. During storage, all conditions relating to the isolation/segregation of the samples from potential sources of volatile compound cross-contamination must be observed.
 - a. Unpreserved samples in sealed vials can be stored at 4°C for 7 days with subsequent freezing at -12°C for up to 14 days from the date of sample collection.
 - b. Sample preserved with sodium bisulfate or methanol can be held at 4°C for 14 days from the date of collection.
 - c. The laboratory should make every effort in order to perform any reanalysis within the applicable holding time.
 - d. It is recommended storage blanks be used to monitor cross-contamination.

6. For the low-level option, all reagents (water, internal standards, etc.) must be introduced into the sample vial so that the air displaced as a result of the additions is trapped as part of the analysis. The addition of reagents can be made using a gas-tight syringe with a 22 gauge or thinner needle.
7. The sample must be agitated during the purging process of low concentration soils.
8. For the high-level option, the test to determine the solvent to use should be performed on the bulk sample. The appropriate solvent should be added to the vial, and the sample should be analyzed or stored at 4°C and analyzed within 14 days of sample collection.
9. Oily waste samples should be processed following the prescribed procedures for sample collection, preparation, and analysis in Method 5035 (section 6.2.4).
10. Field quality control measures should include a trip blank in every sample shuttle that include samples for volatile analysis regardless of the sample collection technique. Field blanks and field duplicates will be submitted as specified in the project plan.
11. The laboratory must report the method of preservation and preparation on the analytical results sheet or case narrative.

Method SW8270C-Semivolatile Organics

Semivolatile organics (also known as base/neutral and acid extractables) in water and soil samples are analyzed using method SW8270C. This technique determines quantitatively the concentration of a number of SVOCs. Samples are extracted and both base/neutral and acid extracts are then concentrated through evaporation. Compounds of interest are separated and quantified using a capillary column GC/mass spectrometer. The RLs are listed in the following tables.

The mass spectrometer is tuned every 12 hours to give an acceptable spectrum for decafluorotriphenylphosphine (DFTPP). The tuning acceptance criteria are given in the following list as an ion abundance for each specified mass:

- mass 51 30 percent to 60 percent of mass 198
- mass 68 less than 2 percent of mass 69
- mass 70 less than 2 percent of mass 69
- mass 127 40 percent to 60 percent of mass 198
- mass 197 less than 1 percent of mass 198
- mass 198 base peak, 100 percent relative abundance
- mass 199 5 percent to 9 percent of mass 198
- mass 275 10 percent to 30 percent of mass 198
- mass 365 greater than 1 percent of mass 198
- mass 441 present, but less than mass 443
- mass 442 greater than 40 percent of mass 198
- mass 443 17 percent to 23 percent of mass 442

The IS method is used for quantitation of analytes of interest. For quantitation, RFs are calculated from the base ion peak of a specific IS that is added to each calibration standard, blank, QC sample, and sample. The calibration, QC, corrective action, and data flagging requirements are given in the following tables.

TABLE C-5.A
RLs for Method SW8270C

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Semivolatile organics	1,2,4-Trichlorobenzene	10.0	µg/L	330	µg/kg
Base/Neutral Extractables	1,2-Dichlorobenzene	10.0	µg/L	330	µg/kg
SW8270C	1,3-Dichlorobenzene	10.0	µg/L	330	µg/kg
	1,4-Dichlorobenzene	10.0	µg/L	330	µg/kg
	2,4-Dinitrotoluene	10.0	µg/L	330	µg/kg
	2,6-Dinitrotoluene	10.0	µg/L	330	µg/kg
	2-Chloronaphthalene	10.0	µg/L	330	µg/kg
	2-Methylnaphthalene	10.0	µg/L	330	µg/kg
	2-Nitroaniline	25.0	µg/L	830	µg/kg

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Semivolatile organics	3-Nitroaniline	25.0	µg/L	830	µg/kg
Base/Neutral Extractables	3,3'-Dichlorobenzidine	10.0	µg/L	330	µg/kg
SW8270C	4-Bromophenyl phenyl ether	10.0	µg/L	330	µg/kg
(continued)	4-Chloroaniline	10.0	µg/L	330	µg/kg
	4-Nitroaniline	25.0	µg/L	830	µg/kg
	Acenaphthylene	10.0	µg/L	330	µg/kg
	Acenaphthene	10.0	µg/L	330	µg/kg
	Anthracene	10.0	µg/L	330	µg/kg
	Benz (a) anthracene	10.0	µg/L	330	µg/kg
	Benzo (a) pyrene	10.0	µg/L	330	µg/kg
	Benzo (b) fluoranthene	10.0	µg/L	330	µg/kg
	Benzo (k) fluoranthene	10.0	µg/L	330	µg/kg
	Benzo (g,h,i) perylene	10.0	µg/L	330	µg/kg
	Bis (2-chloroethoxy) methane	10.0	µg/L	330	µg/kg
	Bis (2-chlorethyl) ether	10.0	µg/L	330	µg/kg
	4-chlorophenyl phenyl ether	10.0	µg/L	330	µg/kg
	Bis (2-ethylhexyl) phthalate	10.0	µg/L	330	µg/kg
	Butyl benzylphthalate	6.0	µg/L	330	µg/kg
	Carbazole	10.0	µg/L	330	µg/kg
	Chrysene	10.0	µg/L	330	µg/kg
	Di-n-butylphthalate	10.0	µg/L	330	µg/kg
	Di-n-octylphthalate	10.0	µg/L	330	µg/kg
	Dibenz (a,h) anthracene	10.0	µg/L	330	µg/kg
	Dibenzofuran	10.0	µg/L	330	µg/kg
	Diethyl phthalate	10.0	µg/L	330	µg/kg
	Dimethyl phthalate	10.0	µg/L	330	µg/kg
	Fluoranthene	10.0	µg/L	330	µg/kg
	Fluorene	10.0	µg/L	330	µg/kg
	Hexachlorobenzene	10.0	µg/L	330	µg/kg
	Hexachlorobutadiene	10.0	µg/L	330	µg/kg
	Hexachlorocyclopentadiene	10.0	µg/L	330	µg/kg
	Hexachloroethane	10.0	µg/L	330	µg/kg
	Indeno (1,2,3-cd) pyrene	10.0	µg/L	330	µg/kg
	Isophorone	10.0	µg/L	330	µg/kg
	n-Nitrosodiphenylamine	10.0	µg/L	330	µg/kg
	n-Nitrosodi-n-propylamine	10.0	µg/L	330	µg/kg
	Naphthalene	10.0	µg/L	330	µg/kg

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
Semivolatile organics	Nitrobenzene	10.0	µg/L	330	µg/kg
	Phenanthrene	10.0	µg/L	330	µg/kg
	Pyrene	10.0	µg/L	330	µg/kg
Acid Extractables	2,2'-oxybis(1-chloropropane)	10.0	µg/L	330	µg/kg
	2,4,5-Trichlorophenol	25.0	µg/L	830	µg/kg
SW8270C	2,4,6-Trichlorophenol	10.0	µg/L	330	µg/kg
(Continued)	2,4-Dichlorophenol	10.0	µg/L	330	µg/kg
	2,4-Dimethylphenol	10.0	µg/L	330	µg/kg
	2,4-Dinitrophenol	25.0	µg/L	830	µg/kg
	2-Chlorophenol	10.0	µg/L	330	µg/kg
	2-Methylphenol	10.0	µg/L	330	µg/kg
	2-Nitrophenol	10.0	µg/L	330	µg/kg
	4-Nitrophenol	10.0	µg/L	330	µg/kg
	4,6-Dinitro-2-methylphenol	25.0	µg/L	830	µg/kg
	4-Chloro-3-methylphenol	10.0	µg/L	330	µg/kg
	4-Methylphenol	10.0	µg/L	330	µg/kg
	Pentachlorophenol	10.0	µg/L	330	µg/kg
	Phenol	10.0	µg/L	330	µg/kg

TABLE C-5.B
QC Acceptance Criteria for Method SW8270C

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc . IS
SW8270C	1,2,4-Trichlorobenzene	44–142	≤ 20	34–152	≤ 30	2
	1,2-Dichlorobenzene	42–155	≤ 20	32–135	≤ 30	1
	1,3-Dichlorobenzene	36–125	≤ 20	26–135	≤ 30	1
	1,4-Dichlorobenzene	30–125	≤ 20	25–135	≤ 30	1
	Bis (2-chloroisopropyl) ether	36–166	≤ 20	26–175	≤ 30	1
	2,4,5-Trichlorophenol	25–175	≤ 20	25–175	≤ 30	3
	2,4,6-Trichlorophenol	39–128	≤ 20	29–138	≤ 30	3
	2,4-Dichlorophenol	46–125	≤ 20	36–135	≤ 30	2
	2,4-Dimethylphenol	45–139	≤ 20	35–149	≤ 30	2
	2,4-Dinitrophenol	30–151	≤ 20	25–161	≤ 30	3
	2,4-Dinitrotoluene	39–139	≤ 20	29–149	≤ 30	3
	2,6-Dinitrotoluene	51–125	≤ 20	41–135	≤ 30	3
	2-Chloronaphthalene	60–125	≤ 20	50–135	≤ 30	3

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc . IS
	2-Chlorophenol	41–125	≤ 20	31–135	≤ 30	1
	2-Methylnaphthalene	41–125	≤ 20	31–135	≤ 30	2
	2-Methylphenol	25–125	≤ 20	25–135	≤ 30	1
	4-Nitrophenol	25–131	≤ 20	25–141	≤ 30	3
	2-Nitroaniline	50–125	≤ 20	40–135	≤ 30	3
	2-Nitrophenol	44–125	≤ 20	34–135	≤ 30	2
	3,3'-Dichlorobenzidine	29–175	≤ 20	25–175	≤ 30	5
	3-Nitroaniline	51–125	≤ 20	41–135	≤ 30	3
	4,6-Dinitro-2-Methyl Phenol	26–134	≤ 20	25–144	≤ 30	4
	4-Bromophenyl phenyl ether	53–127	≤ 20	43–137	≤ 30	4
	4-Chloro-3-Methyl Phenol	44–125	≤ 20	34–135	≤ 30	2
	4-Chloroaniline	45–136	≤ 20	35–146	≤ 30	2
	4-Methylphenol	33–125	≤ 20	25–135	≤ 30	1
	4-Nitroaniline	40–143	≤ 20	30–153	≤ 30	3
	Acenaphthene	49–125	≤ 20	39–135	≤ 30	3
	Acenaphthylene	47–125	≤ 20	37–135	≤ 30	3
	Anthracene	45–165	≤ 20	35–175	≤ 30	4
	Benz (a) anthracene	51–133	≤ 20	41–143	≤ 30	5
	Benzo (a) pyrene	41–125	≤ 20	31–135	≤ 30	6
	Benzo (b) fluoranthene	37–125	≤ 20	27–135	≤ 30	6
	Benzo (g,h,i) perylene	34–149	≤ 20	25–159	≤ 30	6
	Benzo (k) fluoranthene	45–126	≤ 20	46–114	≤ 30	
	Bis (2-chloroethoxy) methane	49–125	≤ 20	39–135	≤ 30	2
	Bis (2-chloroethyl) ether	44–125	≤ 20	34–135	≤ 30	1
	4-chlorophenyl phenyl ether	51–132	≤ 20	41–142	≤ 30	3
	Bis (2-ethylhexyl) phthalate	33–129	≤ 20	25–139	≤ 30	5
	Butyl benzyl phthalate	26–125	≤ 20	25–135	≤ 30	5
	Carbazole	19–177	≤ 20	28–149	≤ 30	
	Chrysene	55–133	≤ 20	45–143	≤ 30	5
	Dibenz (a,h) anthracene	50–125	≤ 20	40–135	≤ 30	6
	Dibenzofuran	52–125	≤ 20	42–135	≤ 30	3
	Diethyl phthalate	37–125	≤ 20	27–135	≤ 30	3

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc . IS
	Dimethyl phthalate	25–175	≤ 20	25–175	≤ 30	3
	Di-n-butyl phthalate	34–126	≤ 20	25–136	≤ 30	4
	Di-n-octyl phthalate	38–127	≤ 20	28–137	≤ 30	5
	Fluoranthene	47–125	≤ 20	37–135	≤ 30	4
	Fluorene	48–139	≤ 20	38–149	≤ 30	3
	Hexachlorobenzene	46–133	≤ 20	36–143	≤ 30	4
	Hexachlorobutadiene	25–125	≤ 20	25–135	≤ 30	2
	Hexachlorocyclopentadiene	41–125	≤ 20	31–135	≤ 30	3
	Hexachloroethane	25–153	≤ 20	25–163	≤ 30	1
	Indeno (1,2,3-c,d) pyrene	27–160	≤ 20	25–170	≤ 30	5
	Isophorone	26–175	≤ 20	25–175	≤ 30	2
	Naphthalene	50–125	≤ 20	40–135	≤ 30	2
	Nitrobenzene	46–133	≤ 20	36–143	≤ 30	2
	n-Nitrosodi-n-propylamine	37–125	≤ 20	27–135	≤ 30	1
	n-Nitrosodiphenylamine	27–125	≤ 20	25–135	≤ 30	4
	Pentachlorophenol	28–136	≤ 20	38–146	≤ 30	4
	Phenanthrene	54–125	≤ 20	44–135	≤ 30	4
	Phenol	25–125	≤ 20	25–135	≤ 30	1
	Pyrene	47–136	≤ 20	37–146	≤ 30	5
	Surrogates:					
	2,4,6-Tribromophenol	25–134		25–144		1
	2-Fluorobiphenyl	43–125		34–135		2
	2-Fluorophenol	25–125		25–135		3
	Nitrobenzene-D5	32–125		25–135		4
	Phenol-D5	25–125		25–135		5
	Terphenyl-D14	42–126		32–136		6
	Internal Standards:					
	1,4-Dichlorobenzene-D4					1
	Naphthalene-D8					2
	Acenaphthalene-D8					3

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)	Assoc . IS
	Phenanthrene-D10					4
	Chrysene-D12					5
	Perylene-D12					6

SW846/8151A - Pentachlorophenol

Method 8151 provides extraction, derivatization, and gas chromatographic conditions for the analysis of chlorinated acid herbicides in water, soil, and waste samples. An option for the hydrolysis of esters is also described. Water samples are extracted with diethyl ether and then esterified with either diazomethane or pentafluorobenzyl bromide. The derivatives are determined by gas chromatography (GC) with an electron capture detector (ECD). The results are reported as acid equivalents. Soil and waste samples are extracted and esterified with either diazomethane or pentafluorobenzyl bromide. The derivatives are determined by GC with an ECD. The results are reported as acid equivalents. Due to the sensitivity of the ECD to halogenated compounds, the report limit is approximately 0.1µg/L and 5µg/Kg. Special analytical instructions are included in Attachment B.

EPA Method 8021

Halogenated and Aromatic Volatile By Gas Chromatography Using
Electrolytic Conductivity And Photoionization Detectors In Series:
Capillary Technique

Method 8021 is used to determine volatile organic compounds in a variety of solid waste matrices. This method is applicable to nearly all types of samples, regardless of water content, including ground water, aqueous sludges, caustic liquors, acid liquors, waste solvents, oily wastes, mousses, tars, fibrous wastes, polymeric emulsions, filter cakes, spent carbons, spent catalysts, soils, and sediments. The following compounds can be determined by this method:

ANALYTE: CAS # Purge-and-Trap Injection

Benzene	71-43-2 b b
Bromobenzene	108-86-1 b b
Bromochloromethane	74-97-5 b b
Bromodichloromethane	75-27-4 b b
Bromoform	75-25-2 b b
Bromomethane	74-83-9 b b
N-butylbenzene	104-51-8 b b
Sec-butylbenzene	135-98-8 b b
Tert-butylbenzene	98-06-6 b b
Carbon Tetrachloride	56-23-5 b b
Chlorobenzene	108-90-7 b b
Chlorodibromomethane	124-48-1 b b
Chloroethane	75-00-3 b b
Chloroform	67-66-3 b b
Chloromethane	74-87-3 b b
2-Chlorotoluene	95-49-8 b b
4-Chlorotoluene	106-43-4 b b
1,2-Dibromo-3-chloropropane	96-12-8 pp b
1,2-Dibromoethane	106-93-4 b b
Dibromomethane	74-95-3 b b
1,2-Dichlorobenzene	95-50-1 b b
1,3-Dichlorobenzene	541-73-1 b b
1,4-Dichlorobenzene	106-46-7 b b
Dichlorodifluoromethane	75-71-8 b b
1,1-Dichloroethane	75-34-3 b b
1,2-Dichloroethane	107-06-2 b b
1,1-Dichloroethene	75-35-4 b b
Cis-1,2-dichloroethene	156-59-4 b b
Trans-1,2-dichloroethene	156-60-5 b b
1,2-Dichloropropane	78-87-5 b b

1,3-Dichloropropane	142-28-9 b b
2,2-Dichloropropane	590-20-7 b b
1,1-Dichloropropene	563-58-6 b b
Cis-1,3-dichloropropene	10061-01-5 b b
Trans-1,3-dichloropropene	10061-02-6 b b
Ethylbenzene	100-41-4 b b
Hexachlorobutadiene	87-68-3 b b
Isopropylbenzene	98-82-8 b b
Para-isopropyltoluene	99-87-6 b b
Methylene Chloride	75-09-2 b b
Naphthalene	91-20-3 b b
N-propylbenzene	103-65-1 b b
Styrene	100-42-5 b b
1,1,1,2-Tetrachloroethane	630-20-6 b b
1,1,2,2-Tetrachloroethane	79-34-5 b b
Tetrachloroethene	127-18-4 b b
Toluene	108-88-3 b b
1,2,3-Trichlorobenzene	87-61-6 b b
1,2,4-Trichlorobenzene	120-82-1 b b
1,1,1-Trichloroethane	71-55-6 b b
1,1,2-Trichloroethane	79-00-5 b b
Trichloroethene	79-01-6 b b
Trichlorofluoromethane	75-69-4 b b
1,2,3-Trichloropropane	96-18-4 b b
1,2,4-Trimethylbenzene	95-63-6 b b
1,3,5-Trimethylbenzene	108-67-8 b b
Vinyl Chloride	75-01-4 b b
Ortho-xylene	95-47-6 b b
Meta-xylene	108-38-3 b b
Para-xylene	106-42-3 b b

Method SW6010B - Trace Elements (Metals) by Inductively Coupled Plasma Emission Spectroscopy (ICPES) for Water and Soil

Samples are analyzed for trace elements using method SW6010B for water and soils. Analysis requires digestion of the sample. Following digestion, the trace elements are determined simultaneously or sequentially using the ICPES technique. Axial or radial view plasmas are acceptable in this method. The elements and corresponding RLs for this method are listed in the following table. The calibration, QC, corrective action, and data flagging requirements are given in the following tables.

TABLE C-9.A
RLs for Method SW6010B

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
ICP Screen for Metals					
SW6010B	Antimony (a)	6	µg/L	1.2	mg/kg
	Arsenic (a)	5	µg/L	1.0	mg/kg
	Barium	5.0	µg/L	1.0	mg/kg
	Beryllium	2.0	µg/L	0.4	mg/kg
	Cadmium	5.0	µg/L	1.0	mg/kg
	Calcium	500	µg/L	100	mg/kg
	Chromium	8.0	µg/L	1.6	mg/kg
	Cobalt	10.0	µg/L	2.0	mg/kg
	Copper	5.0	µg/L	1.0	mg/kg
	Iron	100	µg/L	20	mg/kg
	Lead (a)	5.0	µg/L	1.0	mg/kg
	Magnesium	100	µg/L	40	mg/kg
	Manganese	5.0	µg/L	1.0	mg/kg
	Nickel	20	µg/L	4.0	mg/kg
	Potassium	2000	µg/L	400	mg/kg
	Selenium (a)	5.0	µg/L	1.0	mg/kg
	Vanadium	10	µg/L	2.0	mg/kg
	Silver	10	µg/L	2.0	mg/kg
	Zinc	10	µg/L	2.0	mg/kg

- (a) These metals should be reported by their respective SW846/7000 series methods in Section A-10 unless the required reporting limits can be met by Method 6010B using a trace ICP instrument.

TABLE C-9.B
Matrix Precision and Accuracy Acceptance Criteria for Method SW6010B

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW6010B					
	Antimony (a)	75-125	≤ 20	75-125	≤ 35
	Arsenic (a)	75-125	≤ 20	75-125	≤ 35
	Barium	75-125	≤ 20	75-125	≤ 35
	Beryllium	75-125	≤ 20	75-125	≤ 35
	Cadmium	75-125	≤ 20	75-125	≤ 35
	Calcium	75-125	≤ 20	75-125	≤ 35
	Chromium	75-125	≤ 20	75-125	≤ 35
	Cobalt	75-125	≤ 20	75-125	≤ 35
	Copper	75-125	≤ 20	75-125	≤ 35
	Iron	75-125	≤ 20	75-125	≤ 35
	Lead (a)	75-125	≤ 20	75-125	≤ 35
	Magnesium	75-125	≤ 20	75-125	≤ 35
	Manganese	75-125	≤ 20	75-125	≤ 35
	Nickel	75-125	≤ 20	75-125	≤ 35
	Potassium	75-125	≤ 20	75-125	≤ 35
	Selenium (a)	75-125	≤ 20	75-125	≤ 35
	Silver	75-125	≤ 20	75-125	≤ 35
	Vanadium	75-125	≤ 20	75-125	≤ 35
	Zinc	75-125	≤ 20	75-125	≤ 35

- (a) These metals should be reported by their respective SW846/7000 series methods in Section A.10 unless the required reporting limits can be met by Method 6010B using a trace ICP instrument.

Method SW7470A/SW7471A–Mercury Manual Cold-Vapor Technique

Water and soil samples are analyzed for mercury using methods SW7470A and SW7471A, respectively. This method is a cold-vapor, flame-less atomic absorption (AA) technique based on the absorption of radiation by mercury vapor. Mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an AA spectrophotometer. Mercury concentration is measured as a function of absorbance. The RLs for these methods are listed in the following table. The calibration, QC, corrective action, and data flagging requirements are given in the following tables.

TABLE C-11.A
RLs for Method SW7470A/SW7471A

Parameter/Method	Analyte	Water		Soil	
		RL	Unit	RL	Unit
SW7470A (W)	Mercury	0.5	µg/L	0.1	mg/kg
SW7471A (S)					

TABLE C-11.B
QC Acceptance Criteria for Method SW7470A/SW7471A

Method	Analyte	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
SW7470A/SW7471A	Mercury	75–125	≤ 20	75–125	≤ 35

IGNITABILITY

This section discusses the hazardous characteristic of ignitability. The regulatory background of this characteristic is summarized, and the regulatory definition of ignitability is presented. The two testing methods associated with this characteristic, Methods 1010 and 1020. The objective of the ignitability characteristic is to identify wastes that either present fire hazards under routine storage, disposal, and transportation or are capable of severely exacerbating a fire once started. The following definitions have been taken nearly verbatim from the RCRA regulations (40 CFR 261.21) and the DOT regulations (49 CFR §§ 173.300 and 173.151). Characteristics of Ignitability Regulation A solid waste exhibits the characteristic of ignitability if a representative sample of the waste has any of the following properties:

1. It is a liquid, other than an aqueous solution, containing < 24% alcohol by volume, and it has a flash point < 60EC (140EF), as determined by a Pensky-Martens Closed Cup Tester, using the test method specified in ASTM Standard D-93-79 or D-93-80, or a Setaflash Closed Cup Tester, using the test method specified in ASTM standard D-3278-78, or as determined by an equivalent test method approved by the Administrator under the procedures set forth in Sections 260.20 and 260.21. (ASTM standards are available from ASTM, 1916 Race Street, Philadelphia, PA 19103.)
2. It is not a liquid and is capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes and, when ignited, burns so vigorously and persistently that it creates a hazard.
3. It is an ignitable compressed gas, as defined in 49 CFR 173.300 and as determined by the test methods described in that regulation or by equivalent test methods approved by the Administrator under Sections 260.20 and 260.21.

CORROSIVITY

The corrosivity characteristic, as defined in 40 CFR 261.22, is designed to identify wastes that might pose a hazard to human health or the environment due to their ability to:

1. Mobilize toxic metals if discharged into a landfill environment;
2. Corrode handling, storage, transportation, and management equipment; or
3. Destroy human or animal tissue in the event of inadvertent contact.

In order to identify such potentially hazardous materials, EPA has selected two properties upon which to base the definition of a corrosive waste. These properties are pH and corrosivity toward Type SAE 1020 steel.

The following sections present the regulatory background and the regulation pertaining to the definition of corrosivity. The procedures for measuring pH of aqueous wastes are detailed in Method 9040, Chapter Six. Method 1110, Chapter Eight, describes how to determine whether a waste is corrosive to steel. Use Method 9095, Paint Filter Liquids Test, Chapter Six, to determine free liquid.

The following material has been taken nearly verbatim from the RCRA regulations.

1. A solid waste exhibits the characteristic of corrosivity if a representative sample of the waste has either of the following properties:

- a. It is aqueous and has a pH < 2 or > 12.5, as determined by a pH meter using either the test method specified in this manual (Method 9040) or an equivalent test method approved by the Administrator under the procedures set forth in Sections 260.20 and 260.21.
- b. It is a liquid and corrodes steel (SAE 1020) at rate > 6.35 mm (0.250 in.) per year at a test temperature of 55EC (130EF), as determined by the test method specified in NACE (National Association of Corrosion Engineers) Standard TM-01-69, as standardized in this manual (Method 1110) or an equivalent test method approved by the Administrator under the procedures set forth in Sections 260.20 and 260.21.

REACTIVITY

The regulation in 40 CFR 261.23 defines reactive wastes to include wastes that have any of the following properties: (1) readily undergo violent chemical change; (2) react violently or form potentially explosive mixtures with water; (3) generate toxic fumes when mixed with water or, in the case of cyanide- or sulfide-bearing wastes, when exposed to mild acidic or basic conditions; (4) explode when subjected to a strong initiating force; (5) explode at normal temperatures and

pressures; or (6) fit within the Department of Transportation's forbidden explosives, Class A explosives, or Class B explosives classifications.

This definition is intended to identify wastes that, because of their extreme instability and tendency to react violently or explode, pose a problem at all stages of the waste management process. The definition is to a large extent a paraphrase of the narrative definition employed by the National Fire Protection Association. The Agency chose to rely almost entirely on a descriptive, prose definition of reactivity because most of the available tests for measuring the variegated class of effects embraced by the reactivity definition suffer from a number of deficiencies. A solid waste exhibits the characteristic of reactivity if a representative sample of the waste has any of the following properties:

1. It is normally unstable and readily undergoes violent change without detonating.
2. It reacts violently with water.
3. It forms potentially explosive mixtures with water.
4. When mixed with water, it generates toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment.
5. It is a cyanide- or sulfide-bearing waste which, when exposed to pH conditions between 2 and 12.5, can generate toxic gases, vapors, or fumes in a quantity sufficient to present a danger to human health or the environment. (Interim Guidance for Reactive Cyanide and Reactive Sulfide, Steps 7.3.3 and 7.3.4 below, can be used to detect the presence of reactive cyanide and reactive sulfide in wastes.)
6. It is capable of detonation or explosive reaction if it is subjected to a strong

initiating source or if heated under confinement.

7. It is readily capable of detonation or explosive decomposition or reaction at standard temperature and pressure.

8. It is a forbidden explosive, as defined in 49 CFR 173.51, or a Class A explosive, as defined in 49 CFR 173.53, or a Class B explosive, as defined in 49 CFR 173.88.

TOXICITY CHARACTERISTIC LEACHING PROCEDURE

The Toxicity Characteristic Leaching Procedure (TCLP) is designed to simulate the leaching a waste will undergo if disposed of in a sanitary landfill. This test is designed to simulate leaching that takes place in a sanitary landfill only. The extraction fluid employed is a function of the alkalinity of the solid phase of the waste. A subsample of a waste is extracted with the appropriate buffered acetic acid solution for 18 + 2 hours. The extract obtained from the

TCLP (the "TCLP extract") is then analyzed to determine if any of the thresholds established for the 40 Toxicity Characteristic (TC) constituents (listed in Table 7-1) have been exceeded or if the treatment standards established for the constituents listed in 40 CFR §268.41 have been met for the Land Disposal Restrictions (LDR) program. If the TCLP extract contains any one of the TC constituents in an amount equal to or exceeding the concentrations specified in 40 CFR §261.24, the waste possesses the characteristic of toxicity and is a hazardous waste. If the TCLP extract contains LDR constituents in an amount exceeding the concentrations specified in 40 CFR §268.41, the treatment standard for that waste has not been met, and further treatment is necessary prior to land disposal.

The TCLP consists of five steps:

1. Separation Procedure

For liquid wastes (i.e., those containing less than 0.5% dry solid material), the waste, after filtration through a 0.6 to 0.8 µm glass fiber filter, is defined as the TCLP extract. For wastes containing greater than or equal to 0.5% solids, the liquid, if any, is separated from the solid phase and stored for later analysis.

2. Particle Size Reduction

Prior to extraction, the solid material must pass through a 9.5-mm (0.375-in.) standard sieve, have a surface area per gram of material equal to or greater than 3.1 cm², or, be smaller than 1 cm in its narrowest dimension. If the surface area is smaller or the particle size larger than described above, the solid portion of the waste is prepared for extraction by crushing, cutting, or grinding the waste to the surface area or particle size described above. (Special precautions must be taken if the solids are prepared for organic volatiles extraction.)

3. Extraction of Solid Material

The solid material from Step 2 is extracted for 18 + 2 hours with an amount of extraction fluid equal to 20 times the weight of the solid phase. The extraction fluid employed is a function of the alkalinity of the solid phase of the waste. A special extractor vessel is used when testing for volatile analytes.

4. Final Separation of the Extraction from the Remaining Solid

Following extraction, the liquid extract is separated from the solid phase by filtration through a 0.6 to 0.8 μm glass fiber filter. If compatible, the initial liquid phase of the waste is added to the liquid extract, and these are analyzed together. If incompatible, the liquids are analyzed separately and the results are mathematically combined to yield a volume-weighted average concentration.

5. Testing (Analysis) of TCLP Extract

Inorganic and organic species are identified and quantified using appropriate methods in the 6000, 7000, and 8000 series of methods in this manual or by equivalent methods.

EPA Air Method T014

The analytical strategy for Method T014 involves using a high resolution gas chromatograph (GC) coupled to one or more appropriate GC detectors. Historically, detectors for a GC have been divided into two groups: non-specific detectors and specific detectors. The non-specific detectors include, but are not limited to, the nitrogen-phosphorus detector (NPD), the flame ionization detector (FID), the electron capture detector (ECD) and the photo-ionization detector (PID). The specific detectors include the mass spectrometer (MS) operating in either the selected ion monitoring (SIM) mode or the SCAN mode, or the ion trap detector. The use of these detectors or a combination of these detectors as part of an analytical scheme is determined by the required specificity and sensitivity of the application. While the nonspecific detectors are less expensive per analysis and in some cases more sensitive than the specific detector, they vary in specificity and sensitivity for a specific class of compounds. For instance, if multiple halogenated compounds are targeted, an ECD is usually chosen; if only compounds containing nitrogen or phosphorus are of interest, a NPD can be used; or, if a variety of hydrocarbon compounds are sought, the broad response of the FID or PID is appropriate. In each of these cases, however, the specific identification of the compound within the class is determined only by its retention time, which can be subject to shifts or to interference from other nontargeted compounds. When misidentification occurs, the error is generally a result of a cluttered chromatogram, making peak assignment difficult. In particular, the more volatile organics (chloroethanes, ethyltoluenes, dichlorobenzenes, and various freons) exhibit less well defined chromatographic peaks, leading to misidentification using non-specific detectors. Quantitative comparisons indicate that the FID is more subject to error than the ECD because the ECD is a much more selective detector for a smaller class of compounds which exhibits a stronger response. Identification errors, however, can be reduced by: (a) employing simultaneous detection by different detectors or (b) correlating retention times from different GC columns for confirmation. In either case, interferences on the non-specific detectors can still cause error in identifying a complex sample. The non-specific detector system (GC-NPD-FID-ECD-PID), however, has been used for approximate quantitation of relatively clean samples.

ANALYTE: CAS #

Freon 12	
Dichlorodifluoromethane	75-71-8
Methyl Chloride	74-87-3
Chloromethane	
Freon 114	
1,2-Dichloro-1,1,2,2-tetrafluoroethane	76-14-2
Vinyl Chloride	75-01-4
Chloroethylene	
Methyl Bromide	74-83-9
Bromomethane	
Ethyl Chloride	75-00-3
Chloroethane	
Freon 11	
Trichlorofluoromethane	75-69-4
Vinylidene Chloride	75-35-4
1,1-Dichloroethene	
Dichloromethane	
Methylene Chloride	75-09-2
Freon 113	
1,1,2-Trichloro-1,2,2-trifluoroethane	354-58-5
1,1-Dichloroethane	
Ethylidene Chloride	75-34-3
Cis-1,2-dichloroethylene	
Chloroform	67-66-3
Trichloromethane	
1,2-Dichloroethane	107-06-2
Ethylene Dichloride	
Methyl Chloroform	
1,1,1-Trichloroethane	71-55-6
Benzene 71-43-2	
Cyclohexatriene	
Carbon Tetrachloride	56-23-5
Tetrachloromethane	
1,2-Dichloropropane	78-87-5
Propylene Dichloride	
Trichloroethylene	79-01-6
Trichloroethene	
Cis-1,3-dichloropropene	10061-01-5
Cis-1,3-dichloropropylene	
Trans-1,3-dichloropropene	10061-02-6
Trans-1,3-dichloropropylene	
1,1,2-Trichloroethane	79-00-5
Vinyl Trichloride	
Toluene	108-88-3

Methylbenzene	
1,2-Dibromoethane	106-93-4
Ethylene Dibromide	
Tetrachloroethylene	127-18-4
Perchloroethylene	
Chlorobenzene	108-90-7
Phenylchloride	
Ethylbenzene	100-41-4
Meta-xylene	108-38-3
1,3-Dimethyl Benzene	
Para-xylene	106-42-3
1,4-Dimethyl Benzene	
Styrene	100-42-5
Vinylbenzene	
1,1,2,2-Tetrachloroethane	630-20-6
Ortho-xylene	95-47-6
1,2-Dimethylbenzene	
1,3,5-Trimethylbenzene	
Mesitylene	108-67-8
1,2,4-Trimethylbenzene	
Pseudocumene	95-63-6
Meta-dichlorobenzene	541-73-1
1,3-Dichlorobenzene	
Benzyl Chloride	100-44-7
Alpha-chlorotoluene	
Ortho-dichlorobenzene	955-50-1
1,2-Dichlorobenzene	
Para-dichlorobenzene	106-46-7
1,4-Dichlorobenzene	
1,2,4-Trichlorobenzene	120-82-1
Hexachlorobutadiene	87-68-3
1,1,2,3,4,4-Hexachloro-1,3-butadiene	